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The worlds of agriculture in Asia : agricultural and economic development

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THE WORLDS OF AGRICULTURE IN ASIA: AGRICULTURAL AND ECONOMIC DEVELOPMENT

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To my sons – Omar & Ivan – may this be a source of inspiration for them to achieve whatever they set their minds academically;

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ABSTRACT

The agro-fundamentalists consider agriculture as the engine of growth while agro-pessimists argue that economic growth causes agricultural productivity. It is the main engine of growth in agriculture-based countries; less important in transforming economies; and plays the same role as other tradable sectors in urbanized countries (World Bank, 2008). This work revisits agriculture's role in the development process within the experience of Asia where the majority of the population heavily depends on agriculture.

Chapter 2 presents the results of causality tests between agriculture and economic growth in bivariate systems using the TYDL methodology. For some of agriculture-based Asia (Bhutan, Lao, Cambodia and Pakistan), there is evidence to support the agro-fundamentalists view. Mongolia's economic growth drives agricultural growth. There is no causality running from either direction for Nepal, Vietnam and Bangladesh. No causal relationship between agriculture and economic growth is evident in the transforming economies of Sri Lanka, Indonesia, Philippines and Thailand. Indian and Chinese agriculture contribute to economic growth while the Malaysian economy shows evidence of bidirectional causality.

Chapter 3 investigates the impact of agriculture on economic development in the context of an open economy, as measured by the accession to WTO and Trade Freedom Index, by employing an OLS method. The theory predicts that the openness of economies negatively affects the gains in the economic growth from improvement in agricultural productivity. However, this effect is not strong enough to cause a long-run negative relationship between economic growth and agricultural productivity. Further, the effect does not bring large differences in the gains from agricultural productivity between the open and closed economies in most of Asia.

Chapter 4 examines the role of agriculture in the Korean economy as it transitioned from a predominantly agricultural to an urbanized economy by employing a VARX method. The impact of agriculture is significantly different between the transforming and urbanized stage with the former producing a greater impact. The effect of agriculture is also dependent on the country's stages of economic growth, i.e., Korean agriculture contributes to economic growth in transforming Korea, but not in an agriculture-based and urbanized economy.

CHAPTER 1: INTRODUCTION

"What makes some countries rich and other poor? Economists have asked this question since the days of Adam Smith. Yet after more than two hundred years, the mystery of economic growth has not been solved."

- *Elhanan Helpman (2004)*

Asia[1] is inhabited by most of the world's underprivileged population where agriculture is large both in terms of aggregate income and in terms of total labor force. Its major sub-regions (South, Southeast and East Asia) were home to approximately 55% of the world's total population in 2012 and 73% of the world's agricultural population. Hence, agriculture could continue to play a crucial role in development, especially in these regions of Asia where the agrarian economy is not uncommon. Anderson (2012) believes that the global economic and industrial center of gravity has shifted away from the north Atlantic because of the rapid economic growth in Asian and other emerging economies. Further, accelerated globalization is causing trade to grow much faster than output, especially in Asia, whose share of global merchandise trade has doubled since 1973 to just over 30 percent, with its exports growing at three times the rate for the rest of the world over the past decade. China is now the world's largest exporter, followed by Germany and the United States (WTO, 2010).

The Asian region contains all the three worlds of agriculture as classified by the 2008 World Development Report of World Bank, namely: 1) agriculture-based, 2*)* transforming, and 3) urbanized countries. This classification is based on agriculture's contribution to growth and the rural share in poverty[2]. During the period 1997-2011, Afghanistan, Cambodia, Lao DPR,

[1]The Asian region in this work is taken to include 8 South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka), 7 Southeast Asian countries (Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand and Vietnam), and 3 East Asian countries (China, Mongolia, Rep. of Korea and Japan).

[2] World Bank (2008) categorizes the countries using the past 15 years of data on contribution of agriculture to growth and the current share of total poverty in rural areas with the $2-a-day poverty line. Updating their data, this study classifies countries using 1997-2011 data on contribution of agriculture to GDP (in constant 2000 US$), and

Myanmar, Nepal, Vietnam, Bangladesh, Bhutan, Mongolia and Pakistan constituted the agriculture-based countries, while the urbanized world of agriculture was the developed countries of the region: Japan and South Korea. The remaining developing countries comprised the transforming economies whose agriculture accounted for less than 20 percent of the GDP. On average, the agriculture of Japan and Korea has contributed only 1.3 and 3.8 percent, respectively, to GDP during the past 15 years[3].

There is renewed interest in agriculture motivated by the emerging countries of China and India as they focus on smallholder agriculture in agricultural commercialization as a strategy for reducing the growing gaps between rural and urban incomes (Pingali, 2010). The developed countries, on the other hand, are examining ways of promoting agriculture's multiple roles. Pingali (2010) added that the renewed attention to agriculture might have been triggered by the sharp rise in food prices in 2008, but its persistence in global and national debates points to the growing realization that the problem is not short-lived. Among other things, agriculture in developing countries is faced with the challenges and opportunities of an increasingly globalized food sector and gearing up for the projected negative consequences of climate change.

1.1. Background and Motivation

For the agro-fundamentalists, there is no greater engine for driving growth and thereby reducing poverty and hunger than investing in agriculture, especially in agriculture-based and transforming economies, as in most of Asia. Nevertheless, some authors while accepting this argument conclude that, in an open economy, the linkages between agriculture and industry are less important than in a more closed economy (Dercon 2009, Gollin 2010). They argue that in an

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the share of rural poor to poor during these years. A country whose agriculture contributes more than 20% to GDP and poverty is mostly rural is classified as agriculture-based, transforming if it contributes less than 20% but poverty is still mostly rural, and urbanized if it contributes less than 7% to GDP and poverty is mostly urban.

[3] See Appendix 1 for detailed information in each country.

open economy, importing food and focusing efforts on other sectors might be more beneficial to a country‘s development if it is difficult to increase agricultural productivity. Schiff and Valdez (1998) report that for most of the early development strategies, advocated by Rosenstein-Rodan, Nurkse, and Hirshman among others, emphasize industrial development as the main source of economic growth. They were biased against the agricultural sector. In addition, Moon (2011) writes about the ‘Washington Consensus’ as having preached to African leaders to focus on industrialization along with privatization and deregulation at the expense of agricultural development. This is a manifestation of the mainstream development thinking prior to the 2000s. Imposed by the donor countries, the International Monetary Fund (IMF), and the World Bank, this strategy left African agriculture to lag farther behind the rest of the world.

However, Pingali (2010) reports that the canonical role of agriculture in economic development is being re-discovered by the developing country policy makers as well as managers of foreign assistance in OECD countries and multi-lateral agencies. He further coins the expression “agriculture renaissance” and defines it as the renewed understanding and recommitment to the fundamental role of agriculture in the development process. In similar reasoning, the World Bank (2008) reports that in agriculture-based economies, agriculture can be the primary engine of growth, whereas in transforming countries, agriculture is already less important as an economic activity but is still a major instrument to reduce rural poverty. In urban countries, by contrast, agriculture plays the same role as other tradable sectors and subsectors with a comparative advantage that can help to generate economic growth. It is therefore imperative that the role of agriculture for development be re-evaluated in each specific case because developing countries differ with respect to their economic environments.

1.2. Problem Statement and Research Questions

The historical experience of most Western developed countries is characterized by an industrialization preceded by an agricultural revolution. Recent development economists are less optimistic about the desirability of placing strong emphasis on rapid industrialization arguing that the role of the agricultural sector and the rural economy in the economic development process must be dynamic and possess leading elements rather than playing a passive and supporting role (Todaro, 1997). The World Bank's 2008 World Development Report further argues that growth in the agricultural sector contributes proportionately more to poverty reduction than growth in any other economic sector and that therefore alone, the focus should be on the agricultural sector when aspiring to reach Millennium Development Goals.

Conversely, the agro-pessimists argue that development policy has suffered from an overemphasis on agriculture, driven by an underlying confusion about the causal relationship between agriculture and development (Gollin, 2010). Indeed, agriculture is the largest employer in the poor countries but this sector might have low growth potential. There is also some evidence of industrialization without any preceding agricultural revolution. For instance, the East Asian miracle attained growth without the need for agriculture-based development, i.e., South Korea (Amsden, 1989).

Several empirical studies have been conducted on the relationship between agricultural and economic growth. However, these studies have not without doubt identified the economic relationship between the two. That is, there are still two conflicting views on the role of agriculture in a country's effort to attain a predominantly industrialized society. Conventionally, the agro-fundamentalists consider the growth in the farm sector as the provider of food, raw materials, labor, capital, and foreign exchange necessary to finance subsequent growth in the rest

of the economy, while simultaneously generating an additional demand for industrial goods and services. Recently, the agro-pessimists presented several arguments against the canonical role of agriculture. This has sparks interest by the agricultural economist to find evidence that might support the reverse causality, with growth in the overall economy producing an increase in agricultural productivity via migration of farm workers to the other sectors of the economy.

Given the differing views in the literature, it is imperative that the role of agriculture in the development process be reevaluated based upon the specific economic environment of a country. Centered upon the literature on economic development and set within the experience of the three worlds of agriculture in Asia, this work addresses several timely though complex research questions:

1. Is agriculture the most significant factor in the economic development of agricultural-based Asian economies? Alternatively, is economic stability the factor contributing most to the development of agricultural-based Asian economies? To what extent is a vibrant economy necessary for the growth of the agricultural sector in these agricultural-based Asian economies and, conversely, to what extent is growth in the agricultural sector necessary for a vibrant economy?

2. What is the effect of agricultural growth in an economy with liberalized agricultural trade? What is the impact of agriculture on growth in an open economy?

3. How and to what extent does agriculture contribute to South Korean economic growth as the country evolves from an agricultural-based to a nonagricultural-based economy? Based on economic theory, what changes are expected to occur in the process and how does this compare with observable data?

1.3. Organization of the Dissertation

This work is accomplished and presented through a "journal-article-style" dissertation divided into three chapters. Chapter 2 of the dissertation entitled Agriculture-based and Transforming Asia: Is Agriculture the Engine of Growth?**,** answers the following questions: Is agriculture the most significant factor in the economic development of agricultural-based Asian economies? Alternatively, is economic stability the factor contributing most to the development of agricultural-based Asian economies? To what extent is a vibrant economy necessary for the growth of the agricultural sector in these agricultural-based Asian economies and, conversely, to what extent is growth in the agricultural sector necessary for a vibrant economy? Are these impacts and relationships evident in the transforming Asian economies? This chapter extends the same analysis of this relationship for the transforming economies of Asia to answer the question "Is the relationship the same for the transforming economies of Asia?"

Chapter 3 entitled Does Globalization Make a Difference?, extends the analysis in the previous chapter by arguing that liberalization has an impact on the relationship between agriculture and economic growth. It presents the trends in trade and trade freedom index of these Asian countries in order to assess how much agricultural liberalization has occurred. This chapter further quantifies and determines whether the role of agriculture in economic advancement is dependent on a more liberalized agricultural trade using data from agriculture-based and transforming Asia.

The last chapter, Chapter 4, is entitled Following the Evolutionary Path of South Korea: A Special Empirical Investigation on How Agriculture Contributes to its Urbanization. This part of the dissertation has a particular interest of investigating empirically how agriculture

contributes to South Korean urbanization as it evolved from an agriculture-based society to a transforming economy and finally to an urbanized one.

Finally, a summary of the entire dissertation is presented in Chapter 5, highlighting the conclusions from the three previous chapters and discussing future directions for research.

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CHAPTER 2: AGRICULTURE-BASED AND TRANSFORMING ASIA: IS AGRICULTURE THE ENGINE OF GROWTH?

"It is in the agricultural sector that the battle for long-term economic development will be won or lost."
- *Gunnar Myrdal, 1974 Nobel Laureate in Economics*

"If agriculture can do such great things, why have they not yet happened?"
- *Karen Brooks (2006)*

2.1. Introduction

Agricultural economists have long investigated the role of agriculture in the economic development of a nation. Early analysts such as Lewis (1954) advocated agriculture as the basis for industrial and economic growth as it has an abundance of resources and has the ability to transfer surpluses to the industrial sector. Schultz (1953) propounded that agriculture secured subsistence for the people in the society and without it, there will be no overall economic growth. This long-standing proposition is still supported by contemporary studies viewing agriculture as the vibrant economic sector. In most developing countries, agriculture is both the main sector that provides employment to large segments of the population and the key to sustained economic growth of the countries (Anthony, 2010). There is also substantial empirical evidence supporting a positive relationship between growth in the agricultural sector and overall economic growth.

The possibility for the agricultural sector to generally cause economic development seems persuasive. However, some authors have argued otherwise. As noted by Gardner (2005), some countries of the world attained economic development without a flourishing agriculture sector. In fact, the agro-pessimists go farther with the argument that agriculture plays a trailing role, if any, in the growth of many countries (Gollin, 2010). Gardner (2000) also establishes from a historical analysis of U.S. agricultural development that income growth in the nonfarm sector is more fundamentally important in increasing farm income than any specific agricultural variable. Vast amounts of empirical investigations have been done on the role of agriculture to economic

progress but the evidence is not quite definitive. Several arguments presented in the literature suggest that the causality might run in the opposite direction, i.e., from nonagricultural to agricultural growth.

To contribute to a better understanding of the relationship between the agricultural and overall economic growth, this chapter answers the following questions: Is agriculture the vibrant sector in economic development of the agriculture-based countries of Asia? Alternatively, is a vibrant economy needed in the growth of the agricultural sector of these countries? This chapter seeks to investigate the answers to the foregoing issues based on the experience of the agriculture-based countries in Asia. This chapter also extends the same analysis of this relationship for the transforming economies of Asia to answer the question: Is the relationship the same for the transforming economies of Asia?

The rest of the chapter is organized as follows. The next section reviews the literature investigating the relationship between agriculture and economic growth. The third section outlines the empirical methodology used to assess the relationship. The main findings are the focus of the fourth section. The final section presents the general conclusions and summary of this part of the study.

2.2. Review of Literature

2.2.1. The Agro-Fundamentalist: Agriculture as the Engine of Growth

2.2.1.1. Theoretical Background

In the theories of economic development advocated by Lewis (1954), rapid industrial growth is fueled by the agricultural sector. With lower productivity in agriculture, wages will be higher in the modern sector, which induces labor to move out of agriculture, and into the modern sector, which in turn generates economic growth. He saw agriculture as freeing disguised labor

for industrial production and hence the engine of growth and development of any society must obviously start with agricultural production. Schultz (1953) argued that many poor countries are in a situation of "high food drain," in which they have "a level of income so low that a critically large proportion of the income is required for food." In his view, agriculture is important for economic growth in the sense that it guarantees subsistence for a society without which growth is not possible in the first place. When countries are able to meet the subsistence needs, economic growth will emerge.

On a similar vein with the Lewis model, Johnston and Mellor (1961) support the agro-fundamentalists' view of the importance of agricultural contribution to economic progress especially in the early process of growth. They contend that agriculture does not simply supply food and labor but its role is further established through production and consumption linkages. While providing raw materials to others sectors' production, agriculture demands inputs from the modern sector. As agricultural productivity increase, rural income increases thus creating demand for domestically produced industrial products. As emphasized by Lewis (1954) in his report on industrialization in the Gold Coast, increased rural purchasing power is a valuable stimulus to industrial development. The lack of purchasing power of the rural poor, who comprised the majority of the population, displayed low productivity in agriculture. Hence, with a lack of increased agricultural productivity, there would be no sufficient market for agricultural goods (Nurkse, 1959).

The value of production and consumption linkages is exemplified by Adelman (1984) through his idea of agricultural demand led industrialization (ADLI). The author advocates a development strategy driven by agriculture rather than exports because of these linkages. Increased agricultural productivity should be the initiator of industrialization. He added that

emphasis should be placed on small-to-medium-size farmers because they are more likely to use domestically produced intermediate goods as opposed to large-scale producers who might import machinery and other inputs, which would weaken the linkages between agriculture and other sectors.

2.2.1.2. Empirical Investigation

The view of Schultz above is matched by an observation made by Kuznets (1966) who concludes that the importance of the agricultural sector declines with economic development. Agriculture supplies cheap food and low wage labor to the modern sector. If not, these sectors have limited linkages. When agricultural productivity is achieved, the sector's contribution to economic growth is seen as it releases labor and capital to other sectors in the economy, but the critical force in economic growth is industrial development and agriculture is the traditional, low productivity sector.

In their investigation with the economy of China, de Janvry and Sadoulet (2009) report that during the period 1980 – 2001, the indirect effect through the non-agricultural sector represents only half the effect of agricultural growth to aggregate growth. Yao (2000) also demonstrates how agriculture has contributed to China's economic development using both empirical data and a co-integration analysis. The author finds evidence that agriculture's share in GDP declined sharply over time. However, it is still an important sector for the growth of other sectors. He further concludes that the nonagricultural sectors had little effect on agricultural growth, which was largely due to government policies biased against agriculture and restriction on rural-urban migration. In line with Mellor's findings for non-agricultural employment, multipliers from agriculture to the rest of the economy have been mainly driven by consumption linkages (Thirtle *et al.*, 2003; Tiffin and Irz, 2006).

Using 65 developing countries for the period 1960-85, Timmer (2002) analyzes the relationship between economic and agricultural growth. The author's analysis expands upon the panel data approach to the estimation of endogenous growth models. His findings suggest that a 1% increase in agricultural growth results to a 0.2% increase in the non-agricultural growth. Similarly, Self and Grabowksi (2007) establish a positive relationship between different measures of agricultural productivity and average growth of real GDP per capita over 1960 – 1995 for a cross-section of countries.

Measuring the Johnston-Mellor linkages, empirical work on the regional level has found substantial growth multipliers from exogenous increases in agricultural income. Most of these studies have discovered a higher growth multiplier in agriculture than in non-agriculture. For instance, in Sub-Saharan Africa, the agricultural growth multiplier is substantially larger than previously thought (Delgado *et al.*, 1998). For Kenya, Block and Timmer (1994) calculate the economic growth multiplier associated with additional agricultural income and find it to be nearly three times the magnitude of the growth multiplier for non-agriculture. Specifically, a dollar of agricultural income generates an additional $0.63 of income outside the agricultural sector, while a dollar of non-agricultural income generates only $0.23 of income in the wider economy. Hence, for countries like Kenya, development strategy should follow the agriculture-first approach.

However, the above studies do not show causality because both sectors could have grown in response to other factors, such as macroeconomic policies. The correlation observed could be spurious if both sectors have been growing independently from each other or as a result of a common third factor. As a result, studies that have argued a causal effect of agricultural growth on economic growth have been criticized. To address this issue of endogeneity in empirical

work, Tiffin and Irz (2006), using the Granger causality test and co-integration in the panel data for 85 countries, find evidence that supports the conclusion that agricultural value added is the causal variable in developing countries, while the direction of causality in developed countries is unclear.

Examining the linkages between agricultural growth and the growth of non-agriculture, Bravo-Ortega and Lederman (2005) reach varying conclusions for different economies depending on the level of development. Using panel data from over 120 countries for the period 1960–2000, non-agricultural GDP is regressed on the 1-year lag of agricultural GDP. This is a way to control for the level of development because faster growth in non-agriculture is expected at lower levels of development. The study further employs the Granger causality approach to address the issue of whether agricultural growth leads to non-agricultural growth, or vice versa. For Latin America and the Caribbean (LAC), results show that a 1% increase in agricultural growth contributes to non-agricultural growth by 0.12% and 0.15% for other developing countries. However, these regional averages are not significantly different from each other. Conversely, for the case of high-income countries, agricultural growth has been associated with a subsequent decline in non-agricultural growth. There is also evidence of causality. A 1% increase in the non-agricultural growth rate leads to a decrease in agricultural growth in non-LAC developing countries. In other countries (LAC and developed), non-agricultural growth appears not to be related one way or the other to subsequent agricultural growth.

As reviewed above, it has been established that agricultural development is critical to developing countries, especially the least developed. Agriculture remains the largest employer, the largest source of GDP, and the largest source of exports and foreign exchange earnings in many developing countries (Gollin, 2010). However, while most of the literature views

agriculture as an active and dynamic economic sector, some authors reach quite different conclusions. These are discussed in the sections that follow.

2.2.2. The Agro-Pessimist: Is Agriculture the Engine of Growth?

2.2.2.1. Theoretical Background

Those who are doubtful about the established role of agriculture in economic development put forward several arguments. For instance, Gollin (2010) pointed out that the large share of agriculture in many developing economies does not immediately imply that overall growth has to be based on an ADLI-type strategy. Dercon (2009) believes in the possibility that the causation might run from economic to agricultural growth. If agriculture is not the most productive in the entire economy, e.g., it has no comparative advantage, supporting it is not the best route to economic progress. Growth may be driven by the other sectors of the economy that provide people the prospect of leaving the marginalized farm. Hence, this type of economy is better off exporting nonagricultural goods and importing food than relying on the agriculture-led industrialization.

Paul Collier (2008), an influential figure in development policy, suggests “urban dynamism” as being the key to solving agriculture’s problems. He is against the idea of a smallholder agricultural development strategy. He notes that though the poor earn their livings from smallholder systems, there is little evidence that productivity can increase sufficiently within these systems to generate growth. He then proposes to focus the country’s development efforts on large-scale commercial farms and on the non-agriculture sector, for these could ultimately provide increased livelihood opportunities for the poor.

There are several other arguments put forward by the agro-pessimists. For instance, they contend that increasing agricultural productivity is becoming difficult, as the natural resource

base on which agriculture depends is poor and deteriorating. Skeptics also consider the East Asian miracle as concrete evidence to the case where growth is achieved without the broad-agriculture based development. For the Korean economy, Amsden (1989) conclude that industrialization is achieved without any preceding agricultural revolution.

2.2.2.2. Empirical Studies

Based on panel data of 52 developing countries during 1980-2001, Gardner (2005) concludes that agriculture does not seem to be a primary force behind growth in national GDP per capita. Using a Granger causality test, Katircioglu (2006) analyzes the relationship between agricultural output and economic growth for the closed economy of North Cyprus. For the period 1975-2002, his empirical results suggest that agricultural output growth and economic growth as measured by real gross domestic product growth are in a long-run equilibrium relationship and there are feedback relationships between the variables that indicate bidirectional causation among them in the long run.

Estudillo and Otsuka (1999) explores the changing roles of land and human capital in determining the income of farm households for 3 decades encompassing the pre– and post–Green Revolution periods in Philippines. The authors use annual data of household income collected by the Central Luzon Loop Survey for 4 years from 1966–67 to 1986–87, 1990–91, and 1994–95. The results suggest that growth in the nonfarm economy is the key driver of growth in agricultural wage rates in the Philippines. Gardner (2000) establishes from a historical analysis of U.S. agricultural development that income growth in the nonfarm sector is more fundamentally important in increasing farm income than any specific agricultural variable. Mundlak *et al.,* (2004) analyze the determinants of agricultural growth and various aspects of the agricultural dynamics in Thailand, Indonesia, and the Philippines. They use time series data from

the 1960s until the late 1990s. They conclude in favor of the presence of a clear oversupply of labor in agriculture that is only reinforced by recent technological change in the sector in a comparison of agricultural development in Indonesia, the Philippines, and Thailand.

Gemmell *et al.,* (2000) investigate the issue of inter-sectoral spillovers and interactions between agriculture, manufacturing and services in Malaysia. Their results suggest that growth generating technological change in the manufacturing sector can spillover to agriculture and hence cause growth in that sector. Service output growth on the other hand seems to have been inimical to agricultural growth in both the short- and long-runs, while causality testing supports the case from spillovers rather than "common causes". Butzer and Larson (2002) conclude from a study of inter-sectoral migrations in Venezuela that "as labor migrates from agriculture to nonagriculture, labor productivity in agriculture increases, reducing the inter-sectoral difference." Hwa (1988) believes that growth in the agriculture sector depends largely on the provision of "modern" inputs and technology from the industrial sector. Hence, agriculture might benefit from nonfarm growth.

Gollin (2010) believes that the underlying confusion about the causal relationship between agriculture and development has motivated the agro-pessimists to argue that the development policy has suffered from an overemphasis on agriculture. As pointed here and in the previous sections, empirical investigations are not able to detect a unique causal relationship between the growth of agriculture and its economy. The general idea seems to be one where the contribution of agricultural growth to economic development varies markedly from country to country and from one time period to another within the same economy. These investigations are motivated by the agro-fundamentalist and the more recent agro-pessimist view. To the best of my knowledge, the literature does not present any rigorous cross-country analysis of this

relationship in the case of the agriculture-based and transforming countries of Asia. This chapter aims to fill this gap.

2.3. Data[4] and Methodology

The most prevalent causality approach is grounded in Granger's (1969) work. However, the Granger causality tests cannot be applied without knowing the order of integration and cointegration properties. If the variables are integrated of order one but not cointegrated, then Granger causality tests must be conducted in the first difference form of the Vector Autoregressive (VAR) model. In the presence of cointegration, the error-correction model (ECM) should be used to implement Granger causality tests (Granger, 1988). Hence, pre-tests of a unit root and cointegration are required to select an estimation model for the Granger causality test.

There is therefore a risk in using Granger causality tests in the levels or in difference VAR systems or even in ECMs (Toda and Yamamoto 1995, Rambaldi and Doran 1996). Nuisance parameters and nonstandard distributions enter the limit theory when either of the required rank conditions is not satisfied in the VECM or in the Johansen-Juselius route (Toda and Phillips, 1993, 1994). As per these studies, the multi-step procedure testing causality conditional on the estimation of a unit root, a cointegration rank and cointegration vectors as generally used by previous studies context may suffer from severe pre-test biases.

As a possible solution, Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) (hereafter TYDL) propose a modified version of the Granger causality test which is applicable irrespective of whether the series are integrated or cointegrated of an arbitrary order (Clarke and Mirza, 2006). Therefore, the TYDL causality approach can avoid the pre-testing biases and the

[4]The annual time series data was collected from the 2012 issue of World Development Indicators of the World Bank.

causality results are more reliable. In order to ensure the TYDL causality approach based on levels, the VAR estimation has a standard asymptotic distribution and Toda and Yamamoto (1995) suggest that extra lags have to be added into the models. Hence, the TYDL causality approach is conducted using the levels augmented-VAR model instead of the standard VAR model. Based on two Monte Carlo experiments, Yamada and Toda (1998) and Clarke and Mirza (2006) consistently find that the TYDL causality approach has stable performance and less size distortion than the standard Granger causality tests. The study undertaken by Giles and Mirza (1999) also shows that this augmented lags method performs consistently well over a wide range of systems including near-integrated, stationary and mixed integrated and stationary systems; cases for which the pretesting approaches tended to over detect causality (Giles and Williams, 2000a and 2000b). Therefore, this study employed the TYDL causality approach to verify the direction of causality between agricultural and economic growth. This method is elaborated in the following section.

2.3.1. The TYDL Causality Methodology[5]

The TYDL Granger causality test is a simple procedure requiring the estimation of an "augmented" or "over fitted" VAR that is applicable irrespective of the degree of integration or cointegration present in the system. It uses a modified Wald (*MWALD*) test to test for restrictions on the parameters of the VAR (k) model. This test has an asymptotic chi-squared distribution with ***k*** degrees of freedom in the limit when a ***VAR*** [***dmax*** + k] is estimated (where d***max*** is the maximal order of integration for the series in the system). The following steps are involved in implementing the TYDL causality procedure.

[5] The TYDL causality procedure has been labeled as the long- run causality tests.

1. Determine the nonstationarity properties and the maximal order of integration[6] (denoted as *dmax* in the system). Unit root tests such as Augmented Dickey-Fuller (ADF) and Philips-Perron tests are used to determine *dmax*. The stationarity test is based on the following functions:

$$\Delta Y_t = a_0 + gY_{t-1} + a_1 T + \sum_{i=1}^{p} b_i \Delta Y_{t-i-1} + e_t, \qquad \textit{Eq. 1}$$

where, ΔY is first differences of the variables of interest (i.e., GDP and agriculture); T is the time (trend factor); α_0, constant term (drift); ε_t, a white noise disturbance term and *p*, the lag order. The number of lags *p* in the dependent variable is chosen using the Akaike Information Criteria (AIC) to ensure that the errors are white noise. The lag length, which minimizes the AIC, is considered the appropriate lag of the series under study.

The null and alternative hypotheses of a unit-root test are H_0: $\gamma = 0$; H_1: $\gamma < 0$. For the ADF *t*-statistics, a MacKinnon table (1993) is used. If the coefficient γ is not significant, we fail to reject the null hypothesis of nonstationarity and can conclude that the series is *I*(1) process or higher.

If the first difference regression is stationary, the series variable is said to be integrated of order 1, or I(1), and *dmax*=1. This means all variables are stationary when they are *I*(1). Suppose the test results indicate that the variables of interest have different integration orders, say *I*(1) and *I*(2), then *dmax*=2.

2. Set-up the VAR-model in the levels (i.e., not differenced data). Estimate the VAR-model by Ordinary Least Squares (OLS).

3. Determine the true lag length (k) of the VAR system using some suitable information criteria. The VAR-model is thus VAR (k).

[6] If none of the series is integrated, the usual Granger-causality test can be done.

The lag length of the variables in the VAR (*k*) model is selected using Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC).

4. Add the maximum order of integration *dmax* to the number of lags (k). This is the augmented VAR-model, VAR(*dmax* + k).

5. Carry out misspecification test once the optimal lag length (*k*) and *dmax* are determined (i.e., on the VAR*(dmax* +k) model. This can be done by applying a normality test, autocorrelation, and heteroskedasticity tests.

6. Estimate the unrestricted level *VAR*(*dmax* + k) using some suitable estimation method (usually the SUR or Seemingly Unrelated Regressions technique[7]).

7. Apply standard Wald tests to the first *k* VAR coefficient matrix only in order to conduct inference on Granger causality while the coefficient matrices of the last *dmax* lagged vectors in the model are ignored. This is the modified Wald test (*MWALD*).

The augmented VAR *(dmax+k*) systems are shown in Eqs. (2) and (3).

$$GDP_t = b_0 + \sum_{i=1}^{d\max+k} b_{1i} Agr_{t-i} + m_{1t} \ , \quad \text{Eq. (2)}$$

$$Agr_t = a_0 + \sum_{i=1}^{d\max+k} a_{1i} GDP_{t-i} + m_{1t} \quad \text{Eq. (3)}$$

The Granger non-causality test is done using the MWALD test on the following sets of restrictions:

Ho: β_{1i}=0 for all $i \leq k$

Ho: α_{1i}=0 for all $i \leq k$

For the first restriction, rejection of the null hypothesis concludes that agriculture Granger-causes GDP growth, establishing the conclusion that there is a long-run relationship between

[7]This study followed the SUR routine in SAS to obtain chi-square test as shown by Rambaldi and Doran (1996).

agriculture and GDP. For the second restriction, rejection establishes causality in the opposite direction.

2.4. Results and Discussion

Following Gardner (2003), this analysis used annual time-series data on GDP per capita and agricultural value added per worker[8] Agriculture value added per worker is a measure of agricultural productivity. Value added in agriculture measures the output of the agricultural sector less the value of intermediate inputs. Agriculture comprises value added from forestry, hunting, and fishing as well as cultivation of crops and livestock production (World Bank, 2012).

As calculated by the World Bank (2012) GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2000 US$. The span of the series used in the regression analysis in each country was dictated by data availability. The time series trends were previously described in Section 4.1 on background of Asian agriculture.

2.4.1. Some Background of the Agriculture in Asia

2.4.1.1. Agriculture's Share in GDP and GDP per Capita

Agriculture-based Countries

For the agriculture-based Asian countries, the agricultural sector has contributed in aggregate an average of 32 percent to GDP during the past 15 years (Figure 2.1). The highest, 56 percent, is observed in the case of Myanmar. The GDP per capita increases in agriculture-based Asian countries are accompanied by a decline in the relative importance of agriculture (Figure

[8] [8] Source: World Development Indicators accessible online at http://www.worldbank.org/data/.

2.2)[9]. The share of agriculture in the total GDP of Nepal varied between 65 – 70% during the stagnant growth period of 1965-75, before commencing a steady decline to 40% in 2000 and 38% in 2011. Pakistan experienced slower declines in the share of agriculture GDP from 40% in 1965 to 32% in 1975. In 2000, its share continued to decline, reaching 26%, and, by 2011, 21%. On the other hand, GDP per capita in this country was only $672 in 2012. The corresponding figure is observed lowest in Nepal ($ 275) and highest in Bhutan ($1412).

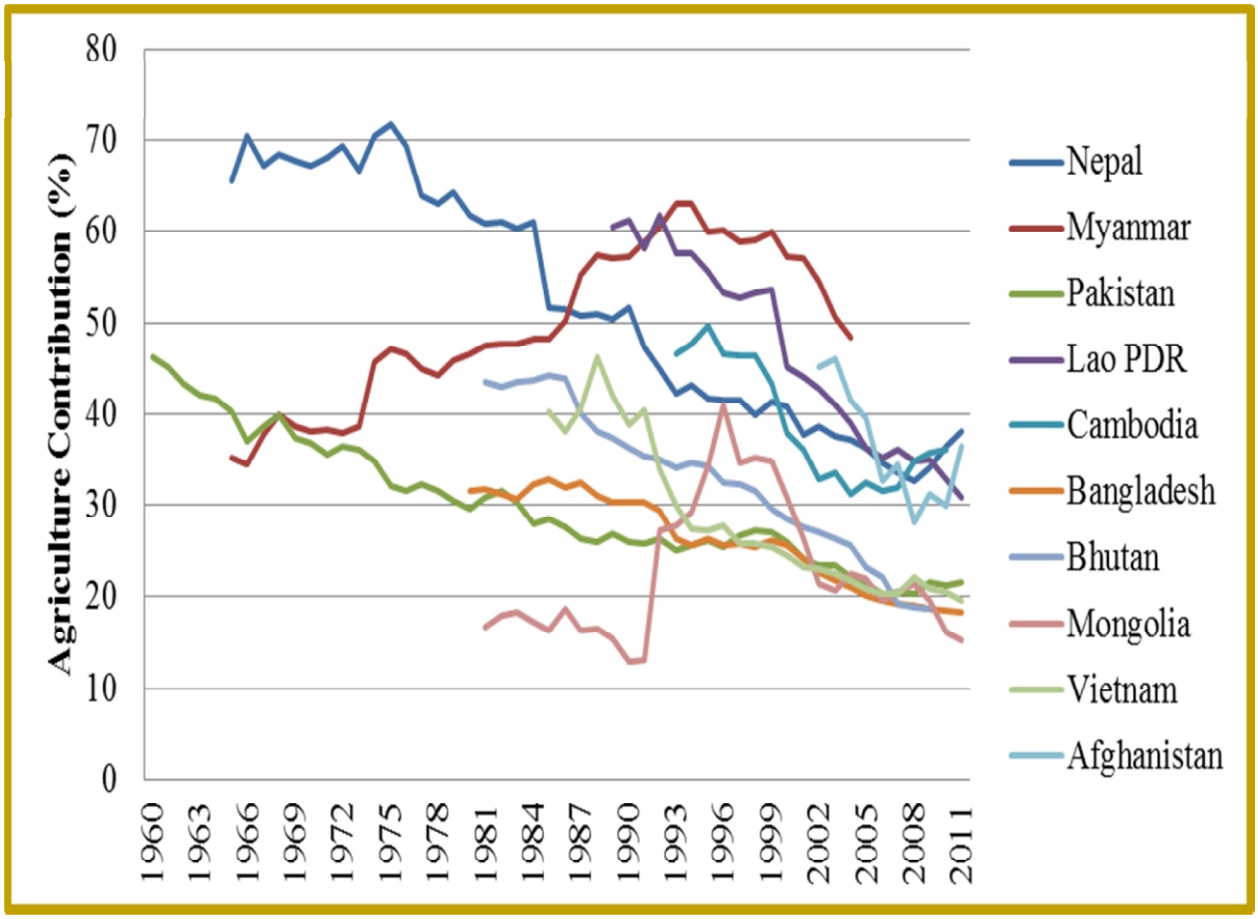


Figure 2.1. Share of Agriculture in GDP: Agriculture-based Countries, 1960-2011.

[9] Except for Myanmar whose trend is unclear.

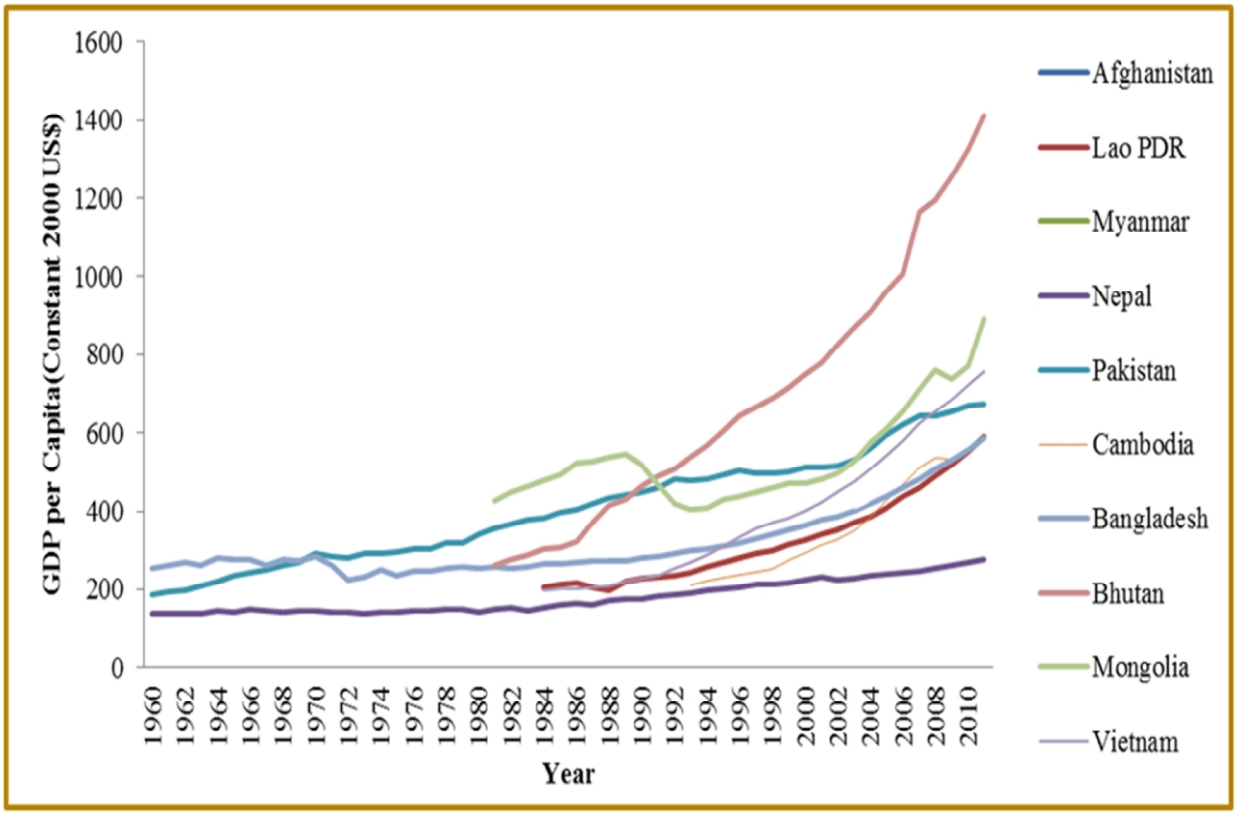


Figure 2.2. GDP per Capita: Agriculture-based Countries, 1960-2011.

Transforming Asian Countries

China and India have evolved from being agriculture-based countries to transforming economies beginning in 1993 and 2002, respectively, when agriculture started to contribute to GDP by about 20% for both countries (Figure 2.3). India's agricultural GDP share declined from 41% to 17% between the early 1960s and 2011. This decline was accompanied by a steady increase of GDP per capita from $181 to $838 during the same period, evidence of the decline of the importance of agriculture in the economy. In China, GDP per capita increased from $106 in 1961 to $2,639 in 2011 while agriculture's contribution declined from 35% to 10% during the same period. All the other transforming Asian economies as classified during the most recent past 15 years (1997-2011) exhibited a downward trend in agriculture's share in GDP matched by an upward trend in GDP per capita (Figure 2.4)**.**

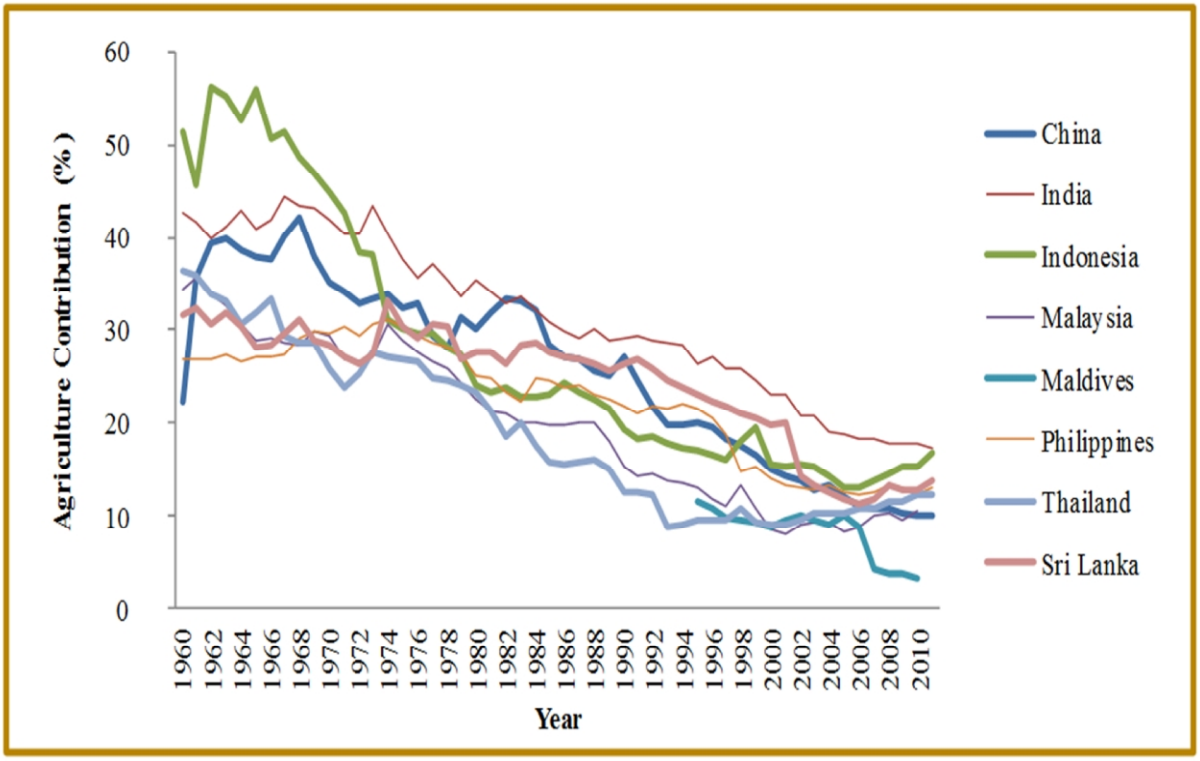


Figure 2.3. Agriculture Share of GDP: Transforming Asia, 1960-2011.

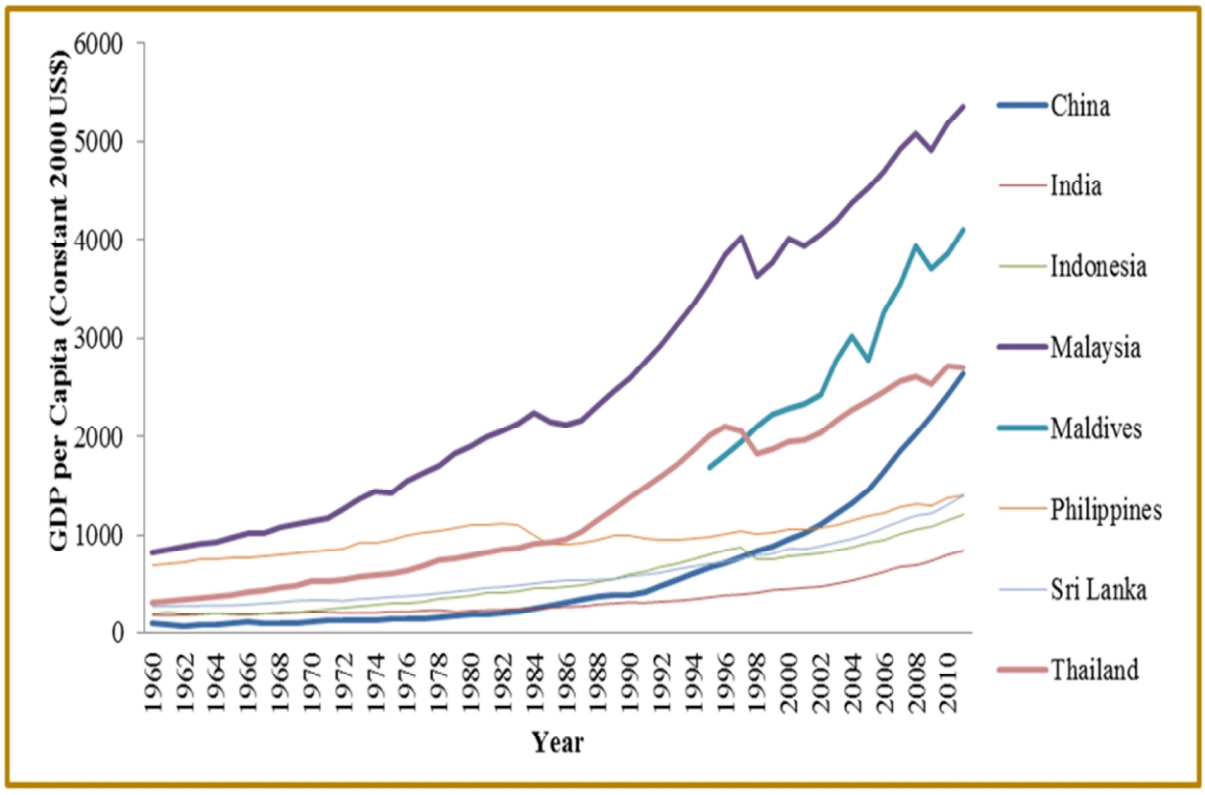


Figure 2.4. GDP per Capita: Transforming Asia: 1960-2011.

Urbanized Asian Countries

Figure 2.5 reflects the case of the urbanized Asian countries. South Korea rapidly evolved from being an agriculture-based economy in 1965, where agriculture contributed 39%, to a transforming country after 14 years as agriculture contributed only 20% to GDP. By another 14 years, it became an urbanized country where agriculture composed only 7% of GDP. In 2010, this sector comprised only 2.56% of its economy. As expected, these declines were coupled with an increasing GDP per capita from a low of $1,153 in 1960 to $16,684 in 2011. Japan, on the other, has been an urbanized country since the 1970s with only a 5% agricultural contribution to GDP. By 2010, agriculture contributed only 1.16% and per capita GDP had increased to $39,578 from only $7,775 in 1960.

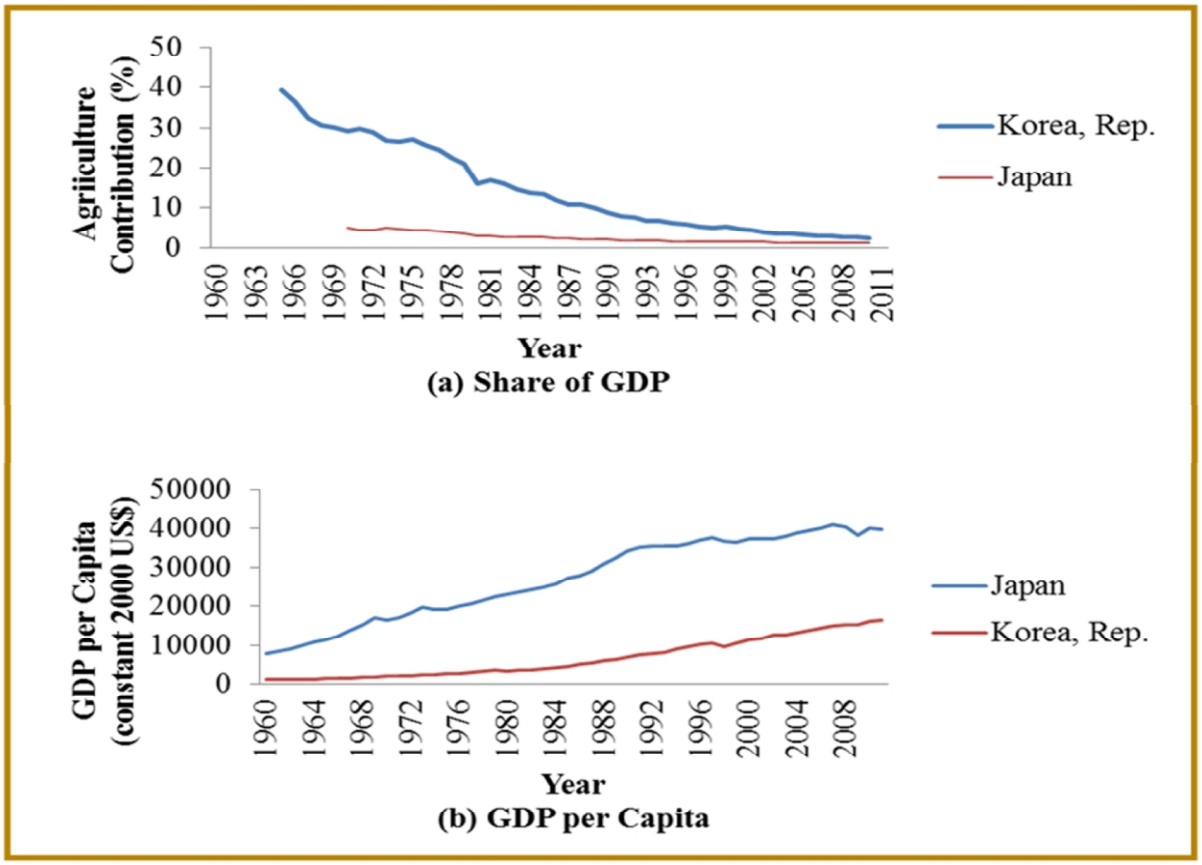


Figure 2.5. Share of Agriculture in GDP (%) and GDP per Capita, Urbanized Asian Countries, 1960-2011

2.4.1.2. Agricultural Value Added per Worker

Agriculture-based Asian Countries

Figure 2.6 shows the 1980-2011 agricultural GDP per worker in these Asian countries that have sufficient data. A big difference in agricultural value added (per worker) is evident even in the same world of agriculture. Nepal and Vietnam both have very low levels of value added, compared to LAO PDR and Pakistan. Mongolia's agricultural productivity has been fluctuating while Bhutan experienced a decline since the early 2000s. As can be seen in the graph, the other countries have experienced increasing agricultural productivity since the 1980s.

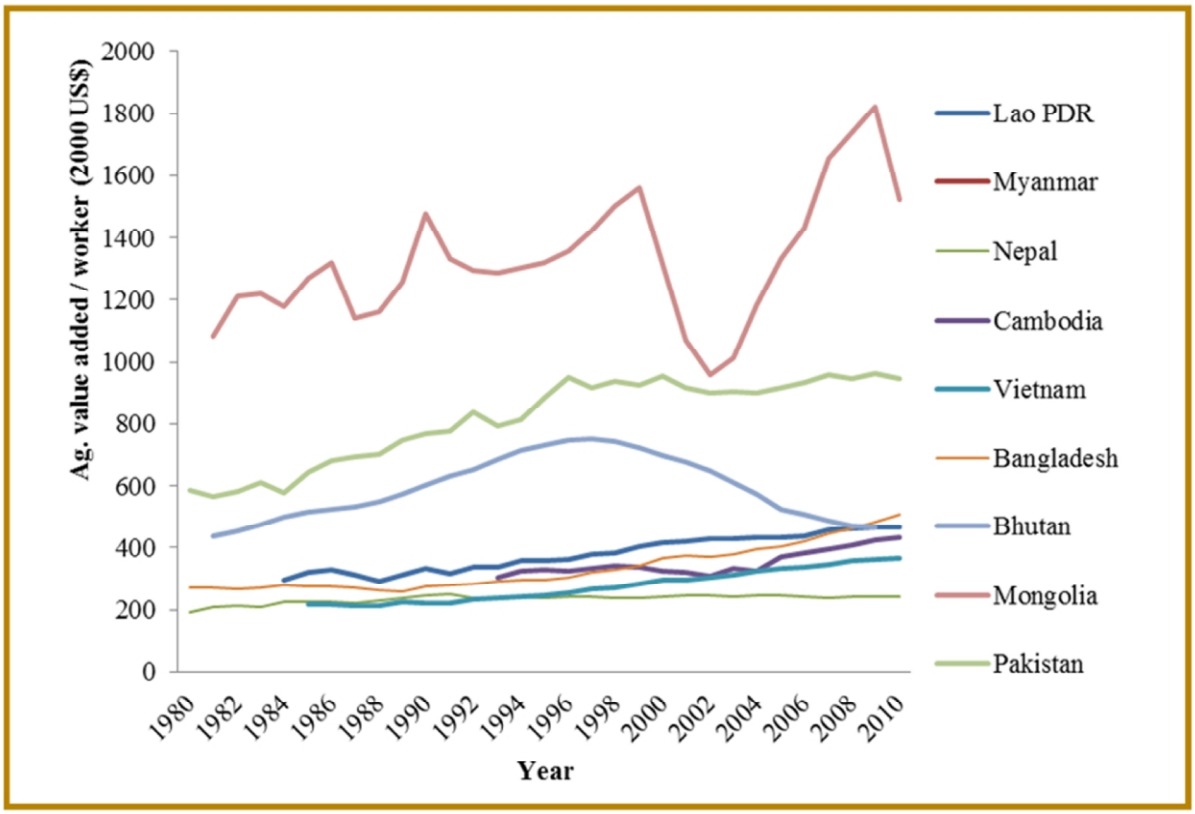


Figure 2.6. Agriculture Value Added per Worker, Agriculture-based Asia, 1980-2011.

Transforming Asian Countries

In aggregate, transforming Asia followed an upward trend in agricultural productivity (Figure 2.7). After almost three decades, Malaysia was able to more than double productivity

from $3,106 in the mid-1980s to $6,689 in 2010. A similar trend is observed in Maldives – from $1,219 to $2,430. However, only these two countries have high levels of agricultural productivity. As shown in Figure 2.7a, China's agricultural productivity tripled from $179 in 1980 to $544 in 2010 (during the last three decades), while India's agricultural productivity almost doubled during the same period (i.e., from $308 to 507). The rest of the transforming Asian countries had agricultural productivity that ranged from $400 to $1,000.

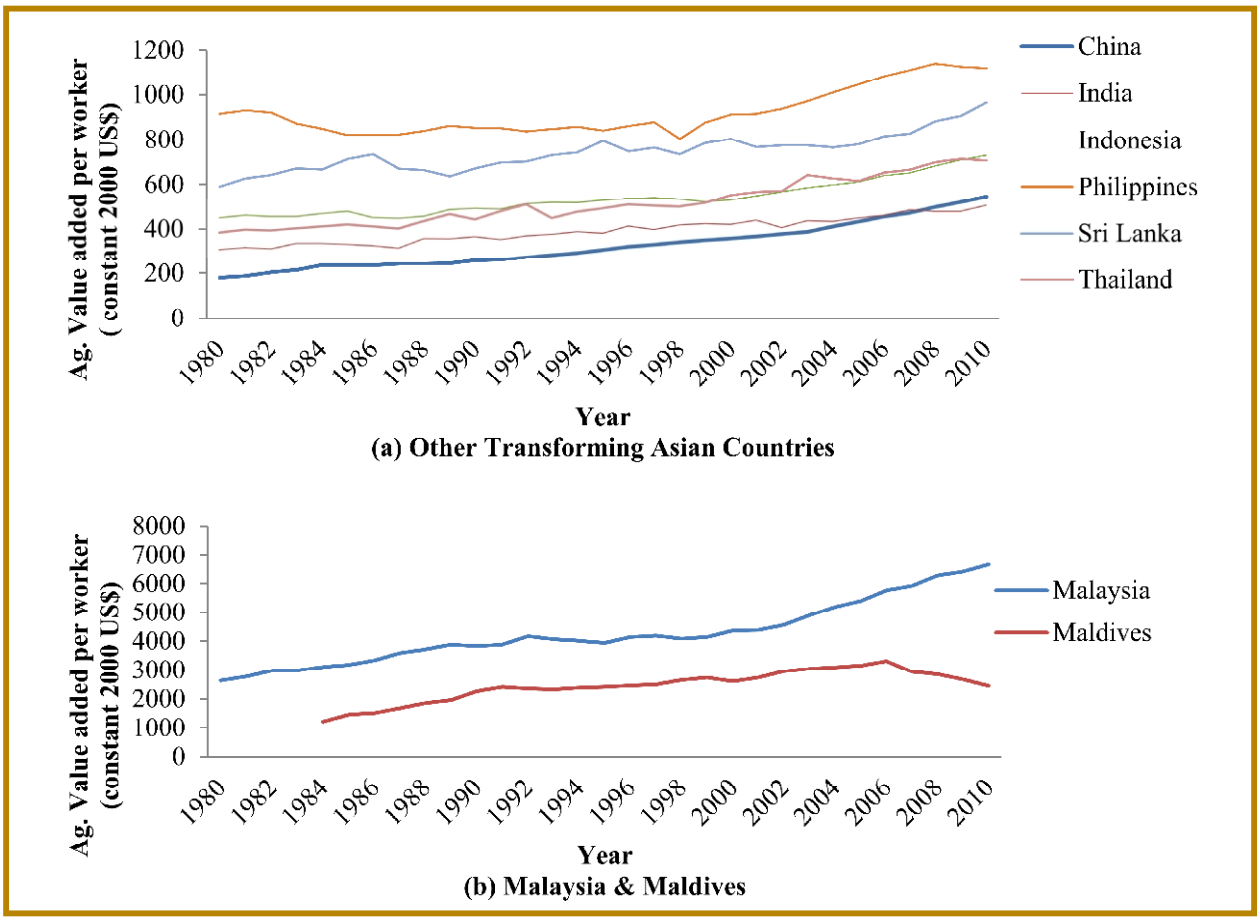


Figure 2.7. Agriculture Value Added per Worker, Transforming Asian Countries, 1980-2011.

Urbanized Asian Economies

Japan's agriculture-value added per worker averaged $22,289 from 1980 to 2011 (Figure 2.8). As the graph shows, over the past 30 years, this indicator trended upward and reached a maximum in 2010 and a minimum value of $11,357 in 1980. In 2001, Japan was the second

largest importer of agricultural products in the world (after the US) and had the largest agricultural trade deficit in the world[10]. The same trend of the Korea's agriculture-value added per worker is displayed, albeit only approximately less than half that of Japan, averaging to only $8,642 during the period 1980-2011. Chapter 4 studies in detail South Korean agriculture's contribution to economic growth.

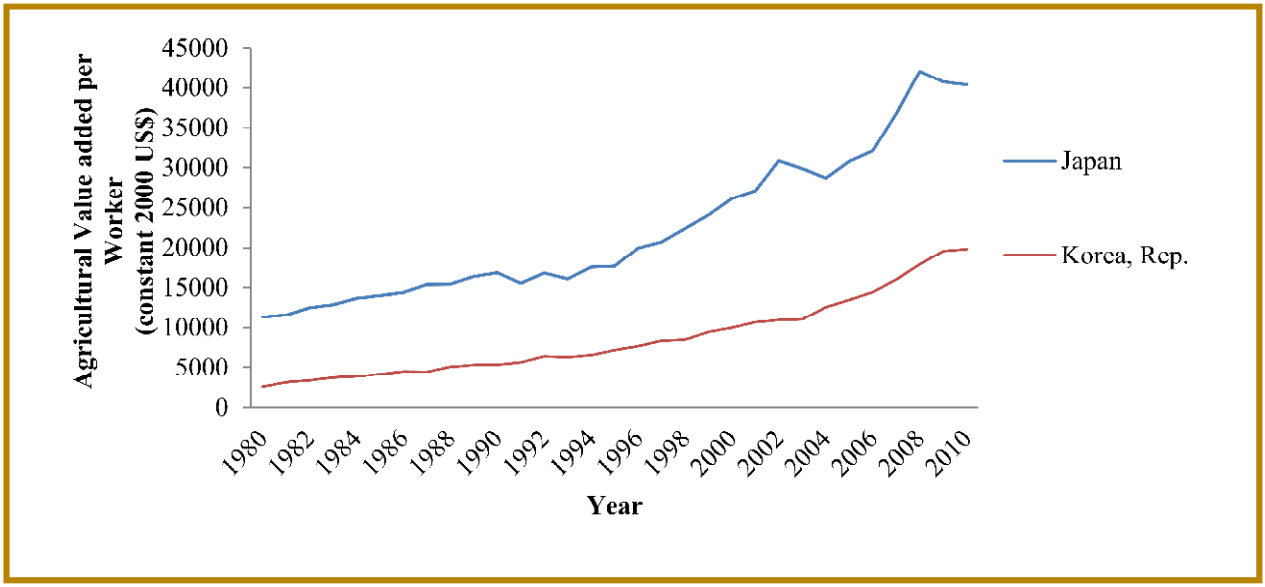


Figure 2.8. Agricultural Value Added per Worker, Urbanized Asian Economy, 1980-2011.

2.4.1.3 Agricultural Population and Employment

Agriculture-based Asian Countries

From 1980, the proportion of the population dependent on agriculture for their livelihood[11] declined slowly in Bangladesh and Pakistan to about 43% in 2010 (Figure 2.9). For Nepal and Bhutan, the corresponding figure has been maintained of over 90% for the last three decades. For Vietnam and Cambodia, about 75% depended on agriculture in early 1980s and

[10] Read more at http://www.nationsencyclopedia.com/Asia-and-Oceania/Japan-AGRICULTURE.html#ixzz2rJjQRgC9

[11] FAO called this as the "economically active population in agriculture" and defines it as "that part of the economically active population that is engaged in or seeking work in agriculture, hunting, fishing or forestry" can also lead to imprecision because it includes casual farm workers.

after three decades, this figure decelerated slowly and ended still high (about 64%). Only Mongolia was able to cut about half this figure on the same period to 18%. Hence, agriculture-based Asian countries continue to depend on agriculture for their livelihood.

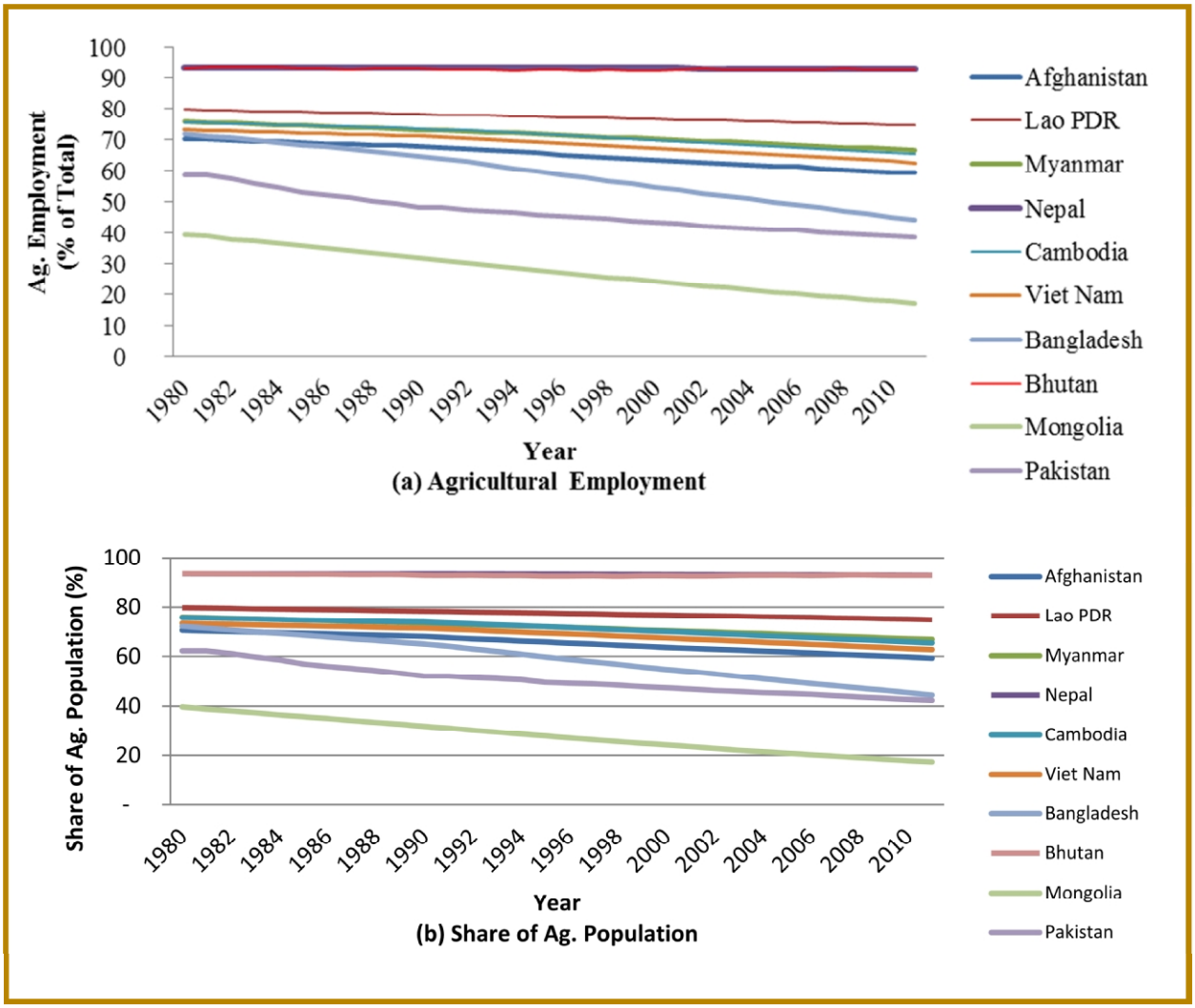


Figure 2.9. Agricultural Employment & Population, Agriculture-based Asia, 1980-2011.

Transforming Asian Countries

Unlike the agriculture-based Asian countries, the proportion of the population dependent on agriculture for their livelihoods declined steadily in all of the transforming Asian countries (Figure 2.10). However, the population active in agriculture was still high even in the Asian Drivers averaging 64% and 51% in China and India, respectively, during the last 15 years.

Except for Malaysia and Maldives, who have low dependence on agricultural livelihood, the corresponding figure was from 41-46 %. This general trend in the withdrawal of labor from the agriculture sector is likely to raise agricultural wages and speed up the commercialization and diversification of farming systems in these Asian economies.

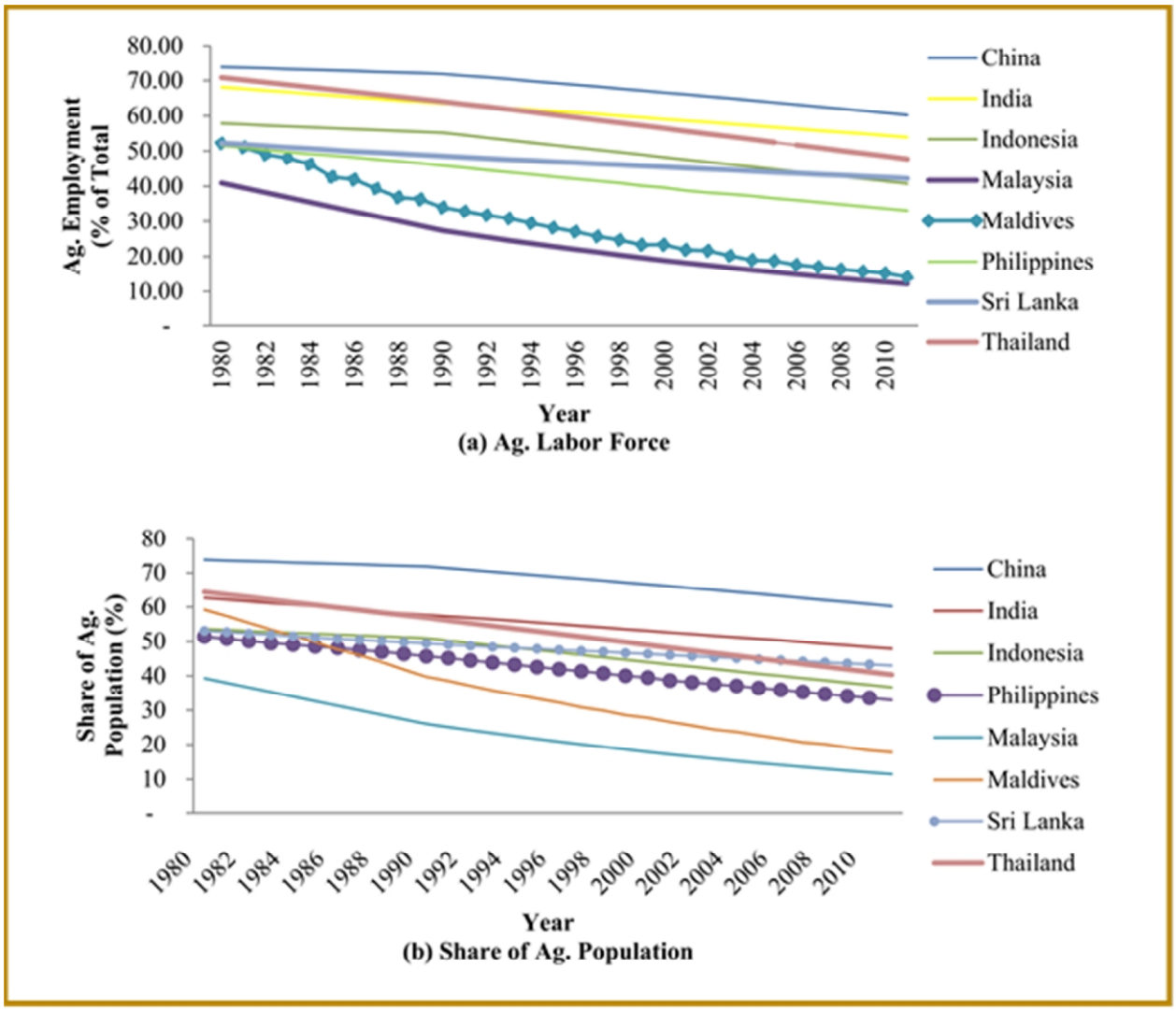
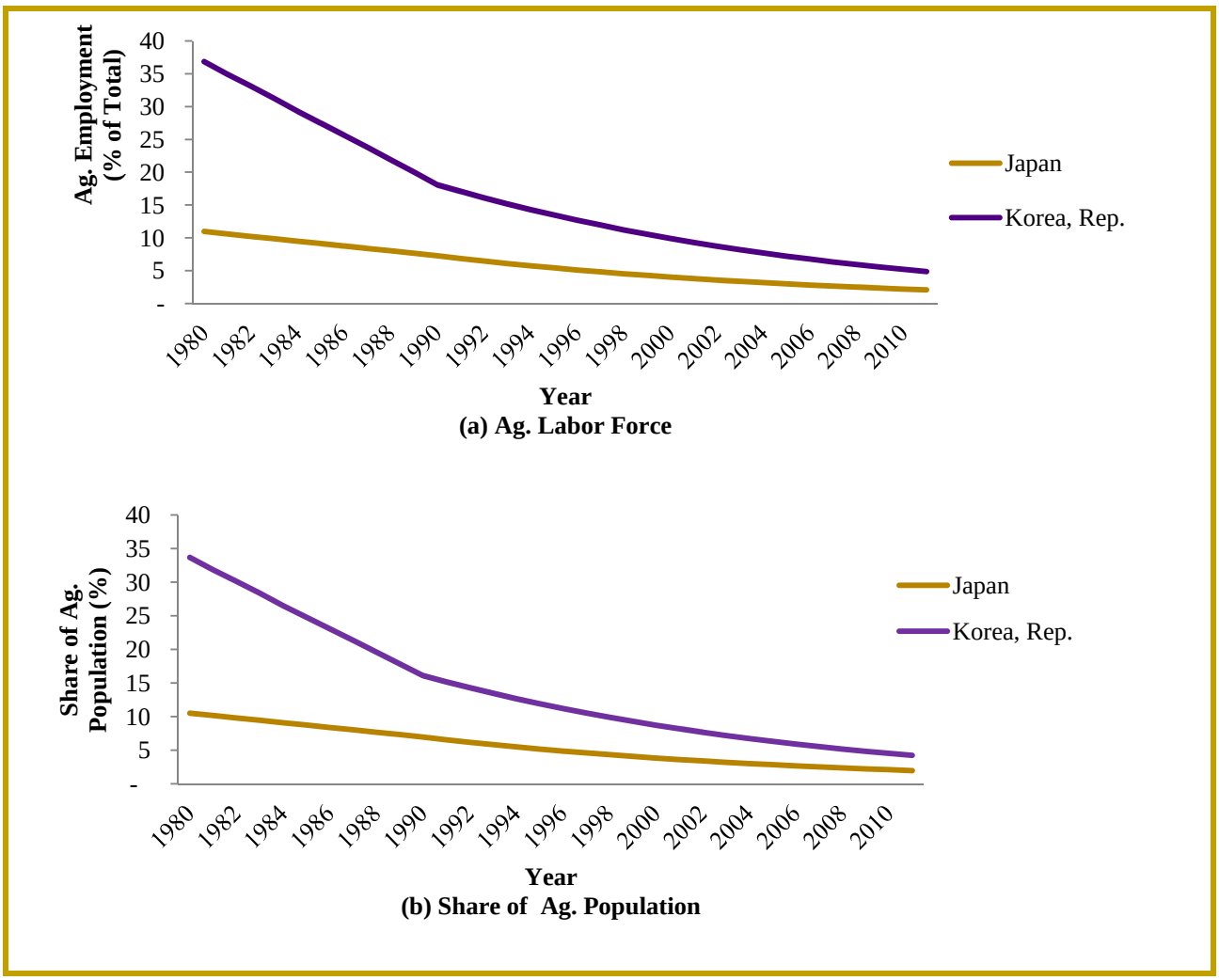


Figure 2.10. Agricultural Employment & Population, Transforming Asia, 1980-2011.

Urbanized Asian Economies

The employment in agriculture for the urbanized countries has been decreasing since the 1980s with South Korea employing more than Japan. However, South Korea's agricultural population is higher than that of Japan (Figure 2.11).



(a) Ag. Labor Force

(b) Share of Ag. Population

Figure 2.11. Agricultural Employment & Population: Urbanized Asia, 1980-2011

2.4.2. Analysis[12] of Time Series Properties

2.4.2.1. Stationarity Tests

The maximum order of integration (*dmax*) was determined using Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests. Results shown in this section are the PP tests (Tables 2.1 and 2.2) while Appendices 2 and 3 report the results of ADF tests.

[12] SAS version 9.2 is used in the data analysis.

Results of Phillips-Perron Test

The results of the PP unit root tests for the AGR and GDP series are presented in Table 2.1 and 2.2, respectively. The column on levels presents the results of testing the series on level forms while the column on first differences tests the unit root process after first differencing the series. Zero mean computes the Phillips-Perron test statistic based on the zero mean autoregressive model, single mean is a model with a constant term while trend computes the PP test based on the autoregressive model with constant and time trend terms.

Agriculture Value Added per Worker (AGR)

Except for Vietnam and Nepal, the result of PP unit root test shows that the agriculture-valued added per worker series failed to reject the null hypothesis of non-stationarity at the 5% significance level (Table 2.1). This indicates that the above-mentioned series on these countries are non-stationary at their level forms. Having determined that the agriculture-value added per worker series (except for the countries of Nepal and Vietnam) is non-stationary in their level forms, the question then becomes: Is the first difference of this series stationary? As shown in Table 2.1, this time series is stationary when differenced once (first differences) for all countries under investigation except for Bhutan. Further testing revealed that for this particular country, it is integrated of order 2.

GDP per Capita

Except for Thailand, the GDP series in level contains a unit root in all countries under analysis (Table 2.2). Collecting the results from the unit root tests on levels and first differences, it can be concluded that countries such as Bangladesh, Cambodia, Mongolia, Vietnam, China and Maldives require higher order differencing (p-value greater than .10). After further testing, it was determined that $I(2)$ was the highest order of integration for these countries. Therefore, the

maximum order of integration (*dmax*) that would be added to the estimation of the VAR systems for these corresponding countries was 2.

Table 2.1. Results of PP Unit Root Test, Agriculture Value Added per Worker (AGR).

Country	AGR					
	Levels			First Differences		
Agriculture-Based	Zero Mean	Single Mean	Trend	Zero Mean	Single Mean	Trend
Bangladesh	0.9999	0.9999	0.9999	0.3202	0.2347	0.0051
Bhutan	0.6673	0.7054	0.9942	0.1958	0.6672	0.7879
Cambodia	0.9893	0.9638	0.9084	0.0009	0.0045	0.0069
Lao	0.9979	0.7895	0.3965	<.0001	0.0003	0.0013
Mongolia	0.7458	0.2075	0.3477	0.0002	0.0040	0.0226
Nepal	0.9608	0.0028	0.0606	<.0001	0.0002	0.0001
Pakistan	0.9878	0.4998	0.9126	<.0001	0.0002	0.0001
Vietnam	0.9999	0.9999	0.0186	0.0732	0.0024	0.0009
Transforming Asia						
China	0.9999	0.9999	0.9999	0.5888	0.1317	0.0325
India	0.9531	0.9869	0.8030	<.0001	0.0007	0.0003
Indonesia	0.9999	0.9999	0.9971	0.0110	0.0104	0.0030
Malaysia	0.9999	0.9999	0.9997	0.1115	0.0198	0.0139
Maldives	0.7458	0.2075	0.3477	0.0002	0.0040	0.0226
Philippines	0.9431	0.9819	0.8019	<.0001	0.0006	0.0003
Sri Lanka	0.9947	0.9487	0.6263	<.0001	0.0002	0.0002
Thailand	0.9999	0.9985	0.4997	<.0001	0.0002	0.0001

Note: Myanmar & Afghanistan has no data on agriculture value-added per worker; hence, no analysis can be done.

Table 2.2. Results of PP Test on GDP per Capita Series.

Country	GDP Per Capita					
	Levels			First Differences		
Agriculture-Based	Zero Mean	Single Mean	Trend	Zero Mean	Single Mean	Trend
Bangladesh	0.9999	0.9999	0.9999	0.9968	0.9952	0.1828
Bhutan	0.9999	0.9999	0.9981	0.0785	0.0022	0.0003
Cambodia	0.9999	0.9982	0.6800	0.4935	0.3122	0.3946
Lao	0.9999	0.9999	0.9999	0.8058	0.7418	0.0111
Mongolia	0.9947	0.9996	0.9990	0.3080	0.5718	0.5288
Nepal	0.9999	0.9962	0.2798	0.0014	0.0002	0.0001
Pakistan	0.9999	0.9643	0.8044	0.0383	0.0149	0.0618
	0.9999	0.9999	0.9186	0.8523	0.5370	0.2502
Transforming Asia						
China	0.9999	0.9999	0.9999	0.9904	0.9845	0.8000
India	0.9308	0.9888	0.9257	0.0060	0.0532	0.0357
Indonesia	0.9999	0.9917	0.7733	0.0126	0.0089	0.0279
Malaysia	0.9999	0.9808	0.3379	0.0013	0.0003	0.0011
Maldives	0.9947	0.9996	0.9990	0.3080	0.5718	0.5288
Philippines	0.9308	0.9888	0.9257	0.0060	0.0532	0.0357
Sri Lanka	0.9999	0.9999	0.9999	0.8582	0.6888	0.0234
Thailand	0.0031	0.0437	0.1427	0.9986	0.8914	0.5120

2.4.2.2. Order of Integration

Table 2.3 summarizes the results of the maximum order of integration (*dmax*). To conduct the Granger causality test, this order was added to the VAR system and a modified Wald test was applied to test for the restrictions. The maximum order of integration in the VAR system is *I*(2). As previously noted in the TYDL methodology, this *dmax* is added to the number of lags (k) in the VAR system; hence, forming the augmented VAR-model, VAR (*dmax* + k).

Table 2.3. Maximum Order of Integration (*dmax)* by Country.

Countries	Maximum order of Integration
Agriculture-Based	
Bangladesh	I(2)
Bhutan	I(1)
Cambodia	I(2)
Lao	I(1)
Mongolia	I(2)
Nepal	I(1)
Pakistan	I(1)
Vietnam	I(2)
Transforming Asia	
China	I(2)
India	I(0)
Indonesia	I(1)
Malaysia	I(1)
Maldives	I(2)
Philippines	I(1)
Sri Lanka	I(1)

2.4.2.3. Determination of Optimal Lag Order in the VAR System

The next step in the analysis is the determination of the optimal lag order in the VAR system. The determination of the optimum *p* is done by running the VAR systems for each country using different lag levels. The criteria used are the Akaike information criterion (AIC) and Schwarz Bayesian Criterion *(*SBC*).*

Following the suggestion of Enders (1995), the lag lengths in each equation were allowed to differ with further inclusion or exclusion of trend term (near-VAR system). To obtain

a more efficient estimate than the ordinary least squares, the near-VAR systems were estimated using seemingly unrelated regression (SUR). The misspecification tests were conducted based on the augmented VAR system. The results are shown in Table 2.4 and Table 2.5. At the 5% level of significance, some countries indicate a problem with the assumptions of normality and homoskedasticity of the residuals in the model (pls. see highlighted results). For all other models, the tests show no deviations from theoretical model assumptions implying the validity of the regression framework.

Table 2.4. Misspecification Test: GDP Equation

COUNTRY	TESTS					
	R^2	DW Pr < t	ARCH (1) Pr > LM	ARCH (2) Pr > LM	Normality Pr > F	RESET Pr > F
Agriculture-Based						
Bangladesh	0.9994	0.3369	0.0197	0.0657	0.7775	0.1293
Bhutan	0.9974	0.3747	0.6395	0.8320	0.8356	0.8191
Cambodia	0.9958	0.3377	0.8201	0.6675	0.1180	0.0650
Lao	0.9985	0.2176	0.2157	0.4646	0.2501	0.6773
Mongolia	0.9681	0.2674	0.5317	0.7396	0.0193	0.5723
Nepal	0.9994	0.2796	0.1077	0.2257	0.6855	0.1180
Pakistan	0.9928	0.1904	0.8967	0.3105	0.7121	0.1036
Vietnam	0.9996	0.1504	0.6202	0.8750	0.6592	0.8937
Transforming Asia						
China	0.9997	0.3213	0.0558	0.1600	0.7036	0.1680
India	0.9767	0.4676	0.1671	0.2001	0.7034	0.7624
Indonesia	0.9836	0.4776	0.9979	0.9945	<.0001	0.0986
Malaysia	0.9641	0.3235	0.5381	0.2874	0.0230	0.2163
Maldives	0.9681	0.2674	0.5317	0.7396	0.0193	0.5723
Philippines	0.9994	0.4629	0.0160	0.0549	0.6086	0.1860
Sri Lanka	0.9975	0.1790	0.7045	0.7180	0.0116	0.2332
Thailand	0.9860	0.1763	0.2483	0.5135	0.2326	0.0365

Note: Jarque-Bera is the test for normality; ARCH is test for autoregressive conditional heteroskedasticity of order 1 and 2. RESET is the Ramsey RESET test, null is no specification problem.

Table 2.5. Misspecification Test: AGR Equation.

COUNTRY	TEST					
	R^2	DW Pr < t h	ARCH (1) Pr > LM	ARCH (2) Pr > LM	Normality Pr > F	RESET Pr > F
Agriculture-Based						
Bangladesh	0.9947	0.4065	0.1967	0.3574	0.9697	0.2497
Bhutan	0.9919	0.1008	0.2457	0.2520	0.0241	0.8849
Cambodia	0.9796	0.4247	0.8962	0.9268	0.6448	0.7377
Lao	0.9613	0.3766	0.6835	0.0478	0.1389	0.8139
Mongolia	0.7918	0.3394	0.7822	0.7884	0.2063	0.7435
Nepal	0.9947	0.4065	0.1967	0.4340	0.9697	0.2497
Pakistan	0.9471	0.1727	0.2684	0.4063	0.6648	0.0767
Vietnam	0.9996	0.1168	0.4416	0.7329	0.7895	0.4217
Transforming Asia						
China	0.9950	0.2347	0.1647	0.3622	0.9594	0.3985
India	0.9340	0.2245	0.0238	0.0216	0.2314	0.5009
Indonesia	0.9839	0.2174	0.5213	0.7728	0.3732	0.4701
Malaysia	0.7918	0.3394	0.7822	0.7884	0.2063	0.7435
Maldives	0.7918	0.3394	0.7822	0.7884	0.2063	0.7435
Philippines	0.9947	0.4065	0.1967	0.4340	0.9697	0.2497
Sri Lanka	0.9102	0.3867	0.5361	0.6053	0.6401	0.1662
Thailand	0.9657	0.1564	0.6291	0.8137	0.3175	0.0014

2.4.2.4. Estimation of Augmented VAR System and the Results of Granger Causality Tests

Based on the results of the previous sections, the augmented near VAR systems using the SUR technique were estimated for each country. The results are given in Tables 2.6 and 2.7. Column 4 of each Table gives the p-value for the null hypothesis of no causality.

Agriculture-Based Countries

Though the agriculture-based Asian countries continue to depend on agriculture for their livelihoods, the results show that only 50% of the agriculture-based countries show evidence of causality running from agricultural value added to GDP. These include the countries of Bhutan, Lao, Cambodia and Pakistan (Table 2.6) while the remaining countries of Nepal, Mongolia, Vietnam and Bangladesh show no evidence of causality. Following the fundamental role of agriculture to economic development, the result came as a surprise for Nepal since the proportion of the population dependent on agriculture for their livelihood has been maintained of over 90%

for the last three decades. The same is true for Bangladesh whose corresponding figure is approximately 51%. For Vietnam, about 75% depended on agriculture in the early 1980s and after three decades, this figure decelerates slowly and ends still high (about 64%). Investigating whether causality runs from GDP to agriculture, only Mongolia showed a significant result. Hence, only 1 out of 8 countries tested, supports the view of the agro-pessimist. Summarizing the results of these two tests, Mongolia exhibits unidirectional causality from economic growth to agriculture growth; Bhutan, Lao, Cambodia and Pakistan need a vibrant agricultural sector to help improve the economy; while the economies of Nepal, Vietnam and Bangladesh exhibit no causal relationship in either direction. Tiffin *et al.*, (2006) found evidence to support that agriculture value added causes GDP growth while bootstrapping the Granger causality test.

Table 2.6. Granger Causality, Agriculture-Based Countries.

No.	Countries	Wald Test	P-value
	Granger Causality Test from Agriculture to GDP[13]		
1	Bangladesh	0.10	0.9056
2	Bhutan	5.27	0.0047
3	Cambodia	10.67	0.0027
4	Lao	3.56	0.0666
5	Mongolia	1.13	0.3339
6	Nepal	0.01	0.9137
7	Pakistan	4.37	0.0184
8	Vietnam	2.45	0.1050
	Granger Causality from GDP to Agricultural growth[14]		
1	Bangladesh	0.34	0.5652
2	Bhutan	0.78	0.3809
3	Cambodia	0.38	0.5409
4	Lao	0.04	0.8336
5	Mongolia	2.64	0.0828
6	Nepal	0.82	0.4650
7	Pakistan	0.26	0.7725
8	Vietnam	0.83	0.3653

[13] Null Hypothesis: Agricultural growth does not cause GDP growth.
[14] Null Hypothesis: GDP growth does not cause Agriculture Growth

The results for countries such as Nepal, Vietnam and Bangladesh do not support the argument of the World Bank 2008 development report stating that agriculture can be the main engine of growth for the agriculture-based countries.

Transforming Asian Countries

The results of the Granger causality test for the transforming Asian countries are presented in Table 2.7. At the 10% level of significance, only 3 out of 8 of countries investigated exhibited a long-run causality running from agriculture to GDP (India, Malaysia and China). Investigating whether causality runs from GDP to agriculture, only 2 out of 8 transforming countries (Maldives and Malaysia) showed significant results. The result for Malaysia further implies that a bi-directional causality exists. The rest of the transforming Asia (Sri Lanka, Indonesia, Philippines and Thailand) exhibits no causal relationship in either direction.

Table 2.7. Granger Causality, Transforming Asian Countries.

No.	Countries	Wald Test	P-value
	Granger Causality Test from Agriculture to GDP[15]		
1	China	2.48	0.0780
2	India	2.72	0.0771
3	Indonesia	2.02	0.1443
4	Malaysia	4.89	0.0321
5	Maldives	1.13	0.3339
6	Philippines	0.43	0.6547
7	Sri Lanka	0.01	0.9056
8	Thailand	0.09	0.7687
	Granger Causality from GDP to Agricultural growth[16]		
1	China	0.23	0.7947
2	India	0.29	0.7488
3	Indonesia	2.76	0.1034
4	Malaysia	2.74	0.0754
5	Maldives	2.64	0.0828
6	Philippines	0.78	0.3809
7	Sri Lanka	0.03	0.8741
8	Thailand	0.4	0.5318

[15] Null Hypothesis: Agricultural growth does not cause GDP growth
[16] Null Hypothesis: GDP growth does not cause Agriculture Growth

The World Bank's 2008 development report cited that agriculture is less important in transforming economies but still instrumental in reducing poverty. India, Malaysia and China support the need for agriculture in economic development. The finding for China is consistent with literature (de Janvry and Sadoulet, 2009 and Yao, 2000).

As shown in the preceding results, the extent to which agriculture enabled overall output growth has, however, varied amongst the countries under investigation. The underlying possible reasons for this conflicting evidence can be spelled out as follows. In the case of agriculture not contributing to economic growth, it could be due to a relatively unfavorable environment for agriculture, (e.g., very limited availability of cultivable land relative to population, climatic conditions). Hence, agriculture could only possibly contribute to growth by means of technological development. It could possibly lie in varying combinations in each of the countries, in both the initial conditions of agriculture and in the policies and strategies pursued.

The level of development of rural infrastructure and of agricultural productivity could certainly play a role on how agriculture influences the overall economy. Moreover, a well-developed communication in rural areas, the provision of a better education and effective government administration could influence agriculture's contribution to growth. The combination of these factors would encourage a wide range of farm households to produce for the market and use commercial inputs with new forms of agricultural technique. That is, due to prior investment in the rural infrastructure, and the pre-existing development of communications and commerce in the rural areas, agricultural output could increase which consequently facilitated the involvement of rural areas in the growth of the economy. The government intervention, along with provision of extension and other services in rural areas could also, in varying degrees, condition agriculture's role. As explored in the next chapter, the agriculture's

contribution to economic may also depend on the openness of the economy to international trade.

2.5. Conclusion and Policy Implication

This chapter presented tests of causality between agriculture and economic growth in bivariate systems using the Toda-Yamamoto and Dolado-Lütkepohl methodology. The empirical results suggest that for half of the agriculture-based countries examined, there is evidence to support the agro-fundamentalists who viewed agriculture as the engine of growth. Hence, the governments of these countries (Bhutan, Lao, Cambodia and Pakistan) could formulate policies that would enhance agricultural development to promote economic growth. The TYDL results for Mongolia indicate that economic growth drives agricultural growth. Hence, the agriculture sector can enjoy prosperity with a healthier overall economy. From a policy perspective for countries whose empirical results suggest no causality running in either direction, such as Nepal, Vietnam and Bangladesh, the government development policy could emphasize enhancing the other sectors of the economy that have a positive impact on economic growth.

The empirical results in the transforming economies of Asia suggest that for most of this group of countries, there is no causal relationship between agriculture and economic growth (Sri Lanka, Indonesia, Philippines and Thailand). Hence, a development policy geared toward improving other sectors could enhance overall economic growth. In countries such as India, Malaysia and China where agriculture contributes to economic growth, a development strategy driven by agriculture (agricultural demand led industrialization), advocated by Adelman (1984) could be followed. For the Malaysian economy, agriculture and overall economic growth drive each other, suggesting that Malaysia can enjoy economic prosperity by investing in agriculture.

At the same time, as the economy prospers, this sector would continue to grow, contributing more to the economy.

Similar to the study of Bravo-Ortega and Lederman (2005), the results of the empirical investigation on the role of agriculture to economic growth on the agriculture-based and transforming Asia reach varying conclusions. Further, such conflicting results are even evident among countries of the same stage of development. Development policies should therefore be tailored to the specific economic environment of a country and that countries should re-investigate their development strategies for possible overemphasis in agriculture. The key variables responsible for the likelihood of success of these countries must be identified along with the conditions in which such strategy is likely to succeed, and ultimately alternative modes of development must be chartered.

Again, for the agro-fundamentalists, there is no greater engine for driving growth and thereby reducing poverty and hunger than investing in agriculture especially in agriculture-based and transforming economies. However, based on the empirical investigation on this chapter, this idea is not supported even in the countries whose livelihood heavily depends on agriculture such as Nepal and Bangladesh. As noted in the previous section, the varying conditions of the countries under study may have contributed to conflicting evidence. In order to determine the underlying similarities and differences in each country, future research that compares and contrasts different experiences of the agriculture-based and Asian countries, as well as identify the key variables mainly responsible for the likelihood of success of the agriculture sector in positively contributing to economic growth is a possible area to study. For this present work, one possible reason for this conflicting evidence, trade openness, is explored.

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CHAPTER 3: DOES GLOBALIZATION MAKE A DIFFERENCE?

> *"The hopes and promises attached to rapid liberalization of trade have not so far been fulfilled in many developing countries; in fact, the latter countries are increasingly becoming marginalized, especially in agriculture."*
>
> - United Nations, 2007

3.1. Introduction

In view of the conflicting empirical results of the previous chapter, the researcher examines the argument in literature that in an open economy, the linkages between agriculture and industry are ***less*** important than in a more closed economy (Dercon 2009). It is further supported by the seminal theoretical paper of Matsuyama (1992) who argues that the relationship between agricultural growth and overall economic growth depends on the openness of a country to international trade. His paper is an attempt to reconcile the apparently conflicting views towards the role of agricultural productivity in the long-run economic growth of countries by arguing that "the key to understanding these two conflicting views can be found in the difference in their assumptions concerning the openness of economies".

Matsumaya (1992) continues to argue that for the closed economy case,, increases in agricultural productivity shifts surplus labor to manufacturing and thereby accelerates economic growth. Therefore, countries having a comparative advantage in agriculture in their early stage of development could speed up their growth and structural transformation by adopting development policies that favor the agricultural sector. However, for the open economies, there exists a negative link between agricultural productivity and economic growth. In an open trading system, where prices are mainly determined by the conditions in the world markets, a rich endowment of arable land (and natural resources) could be a mixed blessing. High productivity and output in the agricultural sector may, without offsetting changes in relative prices, squeeze out the

manufacturing sector and the economy will de-industrialize over time, and, in some cases, achieve a lower welfare level. "Economies which lack arable land and thus have the initial comparative (but not necessarily absolute) advantage in manufacturing, on the other hand, may successfully industrialize by relying heavily on foreign trade through importing agricultural products and raw materials and exporting manufacturing products, as recent experiences in the newly industrialized economies in East Asia suggest. An economy with less productive agriculture allocates more labor to manufacturing and will grow faster. For a sufficiently small discount rate, it will achieve a higher welfare level than the rest of the world." Thus, if the prediction of the model is true, we will have a different policy prescription to developing countries depending on whether or not agriculture is the engine of growth, and whether this relationship is dependent on the country's openness.

While agriculture is the largest employer in these poor developing countries, Gollin (2010) argues that importing food and focusing efforts on other sectors might be more beneficial to a country's development if it is difficult to increase agricultural productivity. The agriculture first policy has been supported in economic literature, but literature has also cited some evidence of industrialization without the precedence of agricultural development (Amsden, 1989). In addition, Schiff and Valdez (1998) report that for most of the early development strategies, advocated by Rosenstein-Rodan, Nurkse, and Hirshman among others, emphasize industrial development as the main source of economic growth. They were biased against the agricultural sector. It is therefore fundamental that analysis of the relationship between agricultural and economic development consider the openness of an economy.

To contribute to a better understanding on the influence of liberalization on the role of agriculture to economic growth, this chapter addresses the questions: Is the effect of agricultural

growth to economic growth dependent on a more liberalized economy as literature argues? If so, is the impact of agricultural growth on economic growth in the developing countries of Asia favorable in the presence of a more liberalized trade? Simply, can agriculture be the engine of growth in an open economy? These are relevant questions as the agriculture of the agriculture-based and transforming Asia faces the growth opportunities and challenges brought about by agriculture trade liberalization.

The rest of this chapter is organized as follows. The next section reviews the literature on the impact of openness to economic growth. The third section outlines the empirical methodology used to investigate whether the effect of agriculture is dependent on the openness of the economy as predicted by some in the literature. The main findings are the focus of the fourth section. The final section presents the general conclusions drawn from the investigation.

3.2. Review of Literature

In nearly all countries of the world, important globalization and increased openness have been taking place. Trade allows each country to specialize in the most efficient production of goods and services that could give her a comparative advantage in a global market. Trade barriers result in production of fewer goods that can be efficiently produced by a country, and more of goods that could be produced efficiently elsewhere. By lowering barriers so that countries may exploit their own specializations, world output will increase and each country can raise its overall consumption and welfare. Theoretically, trade liberalization offers promising gains to a country but alarming distributional issues may pose valid concerns. The beneficial effect of trade is predicted to be applicable to all kinds of goods and services notwithstanding the stage of the development of a trading country (Savadogo, 2007). Hence, the agriculture in Asian economies has growth opportunities given the rapid pace of globalization. However, these

opportunities are not without major challenges. While access to larger and more affluent markets favors growth and development through trade, the agriculture-based and transforming economies face many internal supply-side constraint, associated with their economic underdevelopment, which render their exports uncompetitive. The United Nations (2007) argues that the hopes and promises attached to rapid liberalization of trade have not so far been fulfilled in many developing countries. In fact, the developing countries are increasingly becoming marginalized, especially in agriculture. Further, the opponents of trade reforms in developing countries do not agree that open economies grew more rapidly than closed economies, nor do they believe that trade and investment-led economic growth alleviate poverty.

Based on trade theory, major exporters and importers will benefit from agricultural trade liberalization of the developing countries. An exporter with comparative advantage in agriculture will benefit due to an increased access to markets in developed countries, where relatively higher prices will be received. Benefit of importers is due to cheap imported products from developed countries. The impact of agriculture to overall economic growth depends on the openness of a country to international trade (Matsuyama, 1992). For small closed economies, agricultural productivity will have a positive effect on its economy due to production and consumption linkages advocated by Johnston and Mellor. However, as a country adopts a more liberalized economy, the relation might be reversed.

The linkages between agriculture and the modern sector are less important to economic growth in an open economy because goods in both sectors can be traded (Dercon, 2009). Hence, overall economic growth is due to both sectors reducing the pressure to increase agricultural productivity to attain economic development. As pointed out earlier, if agriculture has no comparative advantage but other sectors have, it is best to import food and focus development

efforts on other sectors to attain economic development. However, if countries are landlocked and closed to international trade, the agricultural sector can be vital to economic progress. Hence, agriculture-first approach is a route to economic development (Dercon 2009, Gollin 2010).

Even the early proponents of the agriculture-first approach to development point out the importance of the degree of openness of a country to economic progress. Imports could potentially substitute for domestic agricultural products (Ranis and Fei, 1961). Not too long ago, Adelman (1984) suggested that agricultural demand led industrialization would work best for low-income countries that are not yet export-driven. As stressed by Foster and Rosenzweig (2003), the tradability of rural non-farm sector goods can have different implications. In a general equilibrium perspective, productivity gains in the agricultural sector have a negative impact on the tradable non-farm sector. This is because agricultural products as well as rural non-farm non-tradables have a relatively inelastic demand for labor, whereas tradable goods have more elastic labor demand. If wages increase due to greater agricultural productivity, factories producing tradable goods, which are assumed to be operated by external producers, will move to escape the higher wages.

As argued by the agro-pessimists, the rural sector has a reduced economic potential as a result of the liberalization of the 1990s and greater openness to trade. For example, cheap imported Chinese plastic buckets out compete the locally produced pottery. However, prices may fall faster than the increase in production due to rapid global technical change and progressively integrated markets. Hence, incomes may fall despite increased productivity if the villagers are net producers (Valdes and Foster, 2005). In addition, Pingali (2010) argues that trade

liberalization could have adverse effects for countries at the low end of the transformation process. This is particularly true in the short run as productive sectors and labor markets adjust.

Further, the work of Moon (2011) challenges the mainstream view that liberalizing agricultural trade will be beneficial for the world overall. The author contends that agriculture is incompatible with free trade because of its innate role in managing ecological/natural resources and the uneven playing field that was created by the way that agriculture has been protected/taxed differently across countries in the past. Liberalizing agricultural trade is not conducive to realizing African agricultural potential because smallholder farmers in Africa cannot compete with the large-scale farmers in middle-income countries or heavily subsidized farmers in developed countries supported by strong infrastructure developed by persistent nurturing over the last six decades (Savadogo, 2007; UN, 2009). Given that African countries have poor infrastructure, limited access to credit and technology, poor domestic agricultural policies, and consequently low productivity, they are not ready to reap the benefits from liberalized trade (Koning and Pinstrup-Anderson, 2007).

Using historical evidence, Chang (2002; 2009) has shown that almost all developed countries including Britain and the US have relied on protectionist policies during the early stages of their industrialization process. He forcefully argues that developing countries of today need to be allowed to use similar protectionist policies in order to gain legitimate chances to succeed in industrialization and catch up with the developed world. Specifically for the case of agriculture, drawing on the experiences from Germany, Korea, and Taiwan, Koning (2007) argues that agricultural protection is required for successful economic development and goes on to propose multilateral regulation of trade volumes instead of multilateral liberalization in light of such need to support agricultural development in developing countries. In a similar vein,

Gonzalez (2002; 2006) argues that "leveling the playing field (liberalizing equally both in developed and developing countries)" would perpetuate economic advantages in the agricultural sector that the developed world has gained as a consequence of "decades of agricultural protectionism and centuries of colonialism".

Batie and Schweikhardt (2009) identify the issue of agricultural trade liberalization as a "wicked problem" in the sense that it is "highly resistant to resolution" as evidenced through the prolonged WTO multilateral talks. They argue that if agricultural trade liberalization was a tame problem, the Doha round would have produced an agreement long ago. They contend that trade liberalization is not a convincing argument insofar as agriculture is concerned. The meager achievement hitherto in reducing trade barriers eloquently speaks to the fact that it is unrealistic to expect developed countries to allow agriculture to be guided solely by market forces. Indeed, Blandford (2010) recognized the problems associated with relying too much on market mechanisms or on government regulations in addressing the interface of agriculture and natural resources and explored the possibility of cooperation in the form of collective actions at local levels.

However, there is some evidence of a positive impact of agricultural trade liberalization using the aggregate economy-wide models (Taylor *et al.*, 2010). This is due to the effect that such agricultural trade reforms have on the nonagricultural sector. Based on the microeconomic agricultural household theory, rural households lose as producers but gain as consumers when prices fall. Hence, the effects of agricultural market liberalization on rural welfare are not clear-cut. Whether the negative production or positive consumption effect dominates is an empirical question, and the answer is likely to vary between different rural household groups. Even the

impacts of agricultural trade reforms on factor prices are ambiguous; they depend on the relative factor intensities of the directly- and indirectly-affected activities.

Hence, Taylor *et al*., (2010) explores the rural welfare impacts of agricultural tariff removal as called for in the Central American Free Trade Agreement (CAFTA) using a disaggregated rural economy-wide modeling (DREM) approach. Based on their results, lower tariffs reduce nominal incomes for nearly all rural household groups in El Salvador, Guatemala, Honduras and Nicaragua. However, they also lower consumption costs substantially. The net effect on rural households' welfare is positive in most cases, implying that pre-CAFTA agricultural protection policies are disadvantageous for most rural household groups.

Obwona *et al*., (2006) report that the competition in the domestic markets of Sub-Saharan African (SSA) economies from agricultural imports from Asian Drivers (ADs) may also have implications for SSA agricultural development. This is particularly the case in situations in which ADs' agricultural imports are cheaper in SSA domestic markets compared to domestically-produced agricultural products. There is growing anecdotal evidence on the impact of ADs imports of manufactured products on SSA domestic industries. Thus, if ADs have comparative advantage in the production of such products, this is likely to displace domestic products in domestic markets. This may in turn lead to a reduction in domestic production and agricultural growth with consequences on income distribution. Jenkins and Edwards (2005) argue that if imports from ADs displace local production of agricultural products, which employ large numbers of unskilled workers, there may be negative effects on the poor. This is also true if displaced products are mainly produced by the smallholder resource-poor farmer. In addition, increased imports from ADs in agricultural products that compete with locally produced products may lead to depressed prices that will create further disincentives to local farmers.

Nonetheless, from a welfare point of view, the overall effects will depend on the extent to which the negative effects on domestic production outweigh the positive effects on depressed consumer prices. This is particularly the case where imports from ADs compete with imports from third countries in SSA domestic markets (Jenkins and Edwards, 2005). Stevens and Kennan (2005) carried out a preliminary review of the impact of imports from China to African consumer welfare and local industries' competitiveness. With respect to the many export sectors, households are set to gain as consumers of Chinese final goods and local producers as users of Chinese imported semi-final goods.

With differing views concerning the impact of agricultural trade reforms in the literature, it is necessary to determine how these reforms can influence the role of agriculture in the fight against poverty and efforts toward economic prosperity. In particular, this research seeks to determine whether the impact of agriculture on economic growth is dependent on the openness of a country, as argued in the literature.

3.3. Data and Methodology

This chapter attempts to empirically examine the impact of trade openness on the relationship between agriculture and economic growth of the agriculture-based and transforming Asian countries by employing Ordinary Least Squares (OLS) regression. The impact of openness of an economy is taken into account through the interaction of the variables that measure or represent free trade with the agricultural value-added per worker. The same measure of economic and agricultural growth in the previous chapter is employed in this analysis. That is, GDP per capita and agricultural value-added per worker from the World Bank are used in the regression. A dummy variable to represent accession to WTO and a trade freedom index are used as measures of openness.

3.3.1. Model 1

A widely used approach to modeling the effect of trade liberalization is by means of mean-shift dummies that switch from zero to one beginning with the year that a country joined the GATT/WTO (Model 1). The dummy variable that represents openness will interact with the variable agriculture value-added per worker in order to take into account the impact of openness on the relationship between GDP per capita and agriculture. The relationship that is estimated is shown as Equation 3.1 below. If openness affects the impact of agricultural productivity on per capita income negatively as the theory predicts, then there will be a negative and statistically significant value as an estimate of the parameter coefficient, α_3, of the interaction variable, D*ln*Agr*.

$$\ln GDP_t = a_0 + a_1 \ln AGR_t + a_2 D_t + a_3 D_t * \ln AGR_t + m_t, \qquad \textit{Eq. 3.1}$$

where:

GDP = GDP per capita
AGR = agriculture value added per worker

D = } 1 with accession to WTO, 0 Otherwise

*D*AGR* = interaction term between the agriculture value added per worker and D
μ = error term

The variables have been transformed into logs of the original values. Explaining economic growth in the framework of equation 3.1 places emphasis differently than in the production function estimation. The use of this equation is to explore quantitatively the influence of agriculture and openness on economic growth.

It is assumed that a country's accession to GATT/WTO affects both the intercept and the slope of agricultural growth. Hence, the regression function for GDP growth with accession to trade (D=1) is shown as Equation 3.2 where α_2 and α_3 give the difference in the intercept and

slope, respectively, before and after the country's accession to WTO. Without trade (D=0), the regression function for GDP growth is shown as Eq. 3.3.

$$\ln GDP_t = (a_0 + a_2) + (a_1 + a_3)\ln AGR_t + m_t, \qquad \textit{Eq. 3.2}$$

$$\ln GDP_t = a_0 + a_1 \ln AGR_t + m_t, \qquad \textit{Eq. 3.3}$$

3.3.2. Model 2

Due to a very simplistic structure of the approach of Model 1, an alternative model specification is also employed (Model 2). In addition, studies have shown that different measures of trade openness resulted in conflicting results; hence, this alternative model also serves as a means of checking the robustness of the effect of the interaction variable. The alternative model uses the trade freedom index (TI) calculated by the Heritage Foundation and Freedom House as a measure of the trade openness of a country. The same model specification as Model 1 is employed in the Model 2 with the dummy variable (D) replaced with the ***TI*.** For clarity, the model is shown as Eq. 3.4.

$$\ln GDP_t = b_0 + b_1 \ln AGR_t + b_2 TI_t + b_3 TI_t * \ln AGR_t + m_t, \qquad \textit{Eq. 3.4}$$

The variables are transformed into logs of the original values with the exception of the openness measure. For both models, a regression is run for each country under investigation. To mitigate the multicollinearity problem, the independent variables were standardized, except for the dummy variable, by the mean-centering method.

3.3.2.1. How Trade Freedom[17] Is Measured

Trade freedom is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services. The trade freedom score is based on two inputs, namely: 1) trade-weighted average tariff rate, and 2) Non-tariff barriers (NTBs).

[17] Source: http://www.heritage.org/index/trade-freedom

Different imports entering a country can, and often do, face different tariffs. The weighted average tariff uses weights for each tariff based on the share of imports for each good. Weighted average tariffs are a purely quantitative measure and account for the basic calculation of the score using the following equation:

$$TI_i = (((tariff_{\max} - tariff_i)/(tariff_{\max} - tariff_{\min})) * 100 - NTB_i \qquad Eq\ 3.5$$

where :

TI = Trade Freedom in country *i;*

$Tariff_{max}$ = upper lower bounds for tariff rates (%);

$Tariff_{min}$ = lower bounds for tariff rates (%);

$Tariff_i$ = weighted average tariff rate (%) in country *i.*

The minimum tariff is naturally zero percent, and the upper bound was set as 50 percent. An NTB penalty is then subtracted from the base score. The penalty of 5, 10, 15, or 20 points is assigned according to the scale listed in Appendix 6. [18] In addition to being transparent in the method used to calculate the trade freedom index, the mathematical specification also covers both the tariff and non-tariff barriers; hence, this index is deemed a reasonable measure of openness.

3.4. Results and Discussion

3.4.1. Accession of Asia to the WTO

Table 3.1 shows the accession of Asia under investigation to the GATT/WTO. Three of the countries in agriculture-based Asia joined the WTO in 1995 (Bangladesh, Myanmar, and Pakistan); two are still observers (Bhutan and Lao); in 1997 Mongolia joined; Cambodia and Nepal in 2005 while Vietnam joined more recently (2007). Except for China, who joined the

[18] Source: http://www.heritage.org/index/trade-freedom

WTO in 2001, the rest of the transforming Asian countries have been members of the WTO since 1995 including the urbanized countries of Japan and South Korea.

Table 3.1. Accession to WTO of Asian Countries Under Study[19].

Country	Date of Accession
Agricultural-Based Asia	
Bangladesh	01 January 1995
Bhutan	Observer
Cambodia	13 October 2004
Lao PDR	Observer
Mongolia	29 January 1997
Myanmar	01 January 1995
Nepal	23 April 2004
Pakistan	01 January 1995
Vietnam	11 January 2007
Transforming Asia	
China	11 December 2001
India	01 January 1995
Indonesia	01 January 1995
Malaysia	01 January 1995
Maldives	31 May 1995
Philippines	01 January 1995
Sri Lanka	01 January 1995
Thailand	01 January 1995
Urbanized Asia	
South Korea	01 January 1995
Japan	01 January 1995

3.4.2. Trade Freedom Index

The depth and extent of trade openness in a country can be gauged using the trade freedom index measured by the Trade Freedom House and Heritage Foundation. As presented in Section 3.3.2.1, this index is measured using the country's trade-weighted average tariff rate and its extent of use of non-tariff barriers. A country is classified as "free" if the trade freedom score is 80-100, "mostly free" if the score is 70-79.9 and so forth (Figure 3.1). The following sections

[19] Source: WTO website: http://wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm

discuss the ranking of each country under study in terms of trade freedom with the rest of the agriculture-based and transforming Asia and the world.

3.4.2.1. Agriculture-based Asia

Figure 3.1 presents the trade freedom trend for the agriculture-based countries. According to this measure, most of the agriculture-based countries have not undertaken greater trade liberalization than other developing countries. The average index for this group in 2013 is 66.87 which the Heritage Foundation regards only as ”moderately free.” This index value is less than the average of the transforming Asian countries of 69.8 and further below the world average of 88.07 (Figure 3.2) which is considered as a ”free economy.”

Mongolia’s trade freedom score is 79.8, making its trading the 1st freest in 2013 for both the agriculture-based and transforming economies under investigation (total of 15 countries). However, its world ranking in terms of trade freedom is only 71st. Figure 3.2 presents its detailed ranking in 2013**.** The Mongolian trade freedom score is above the average of the countries under study of 68.42 and below the world average trade freedom of 88.07. The trade-weighted average tariff rate is 5.1 percent, and costly non-tariff barriers further constrain trade freedom.

Vietnam ranks 2nd among the agriculture-based and transforming countries investigated whose trade freedom index is above the average of these countries. However, its index is still below the average of the world and the freest economies. Vietnam’s trade-weighted average tariff rate is 5.7 percent, with some additional non-tariff barriers limiting more dynamic gains from trade.

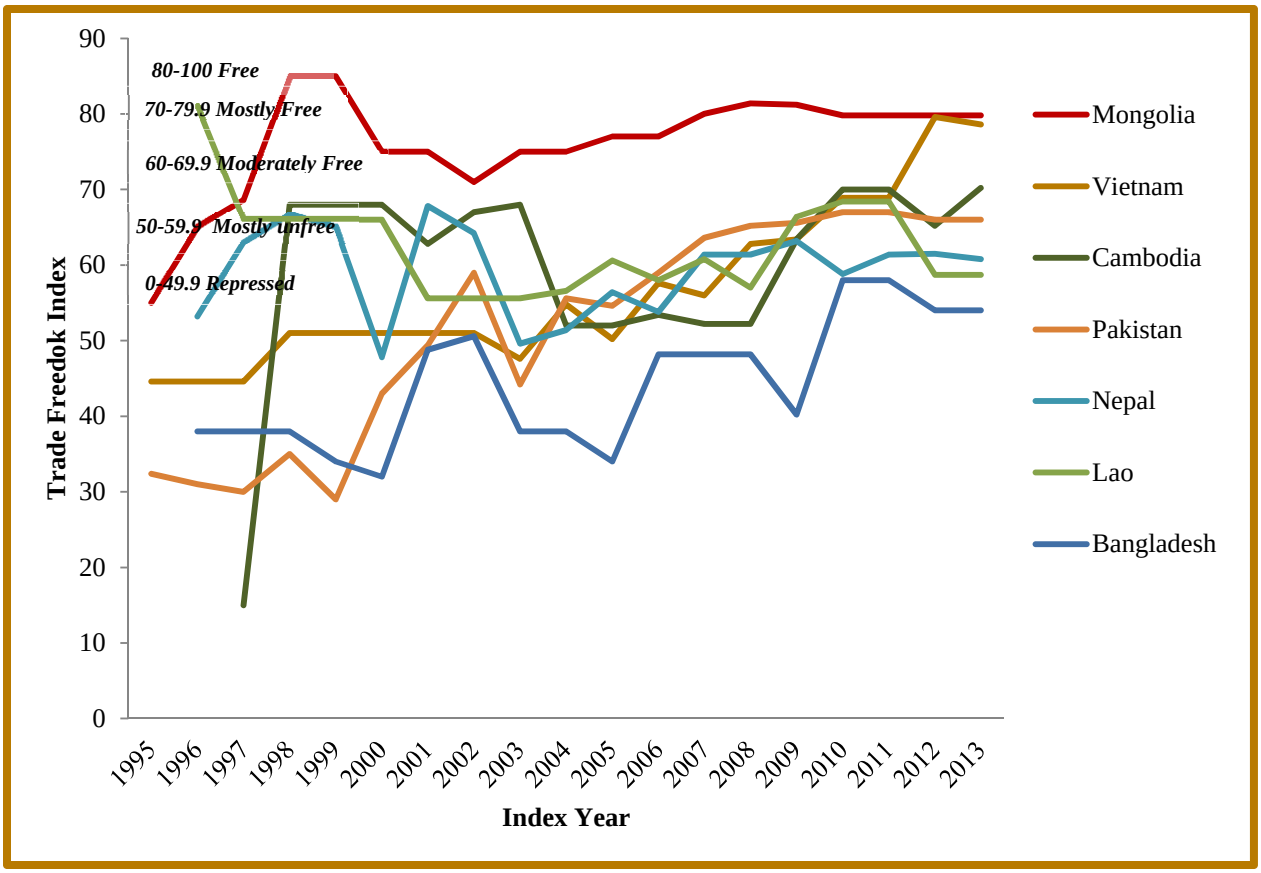

Figure 3.1. Trade Freedom Index: Agriculture-Based Asia, 1995-2013.

In 2013, Cambodia and Pakistan ranked 3rd and 4th among the 7 agriculture-based countries, respectively. However, the same countries ranked 9th and 10th among the 15 agriculture-based and transforming economies under study. Their trade freedom index is below both the world average and free economies. Pakistan ranks 141st in the world in trade freedom while Cambodia ranks 123rd. Cambodia's trade-weighted average tariff is 5.5 percent, and the country is improving its trade policies while Pakistan is very high at 9.5 percent, and complex non-tariff barriers further constrain trade freedom.

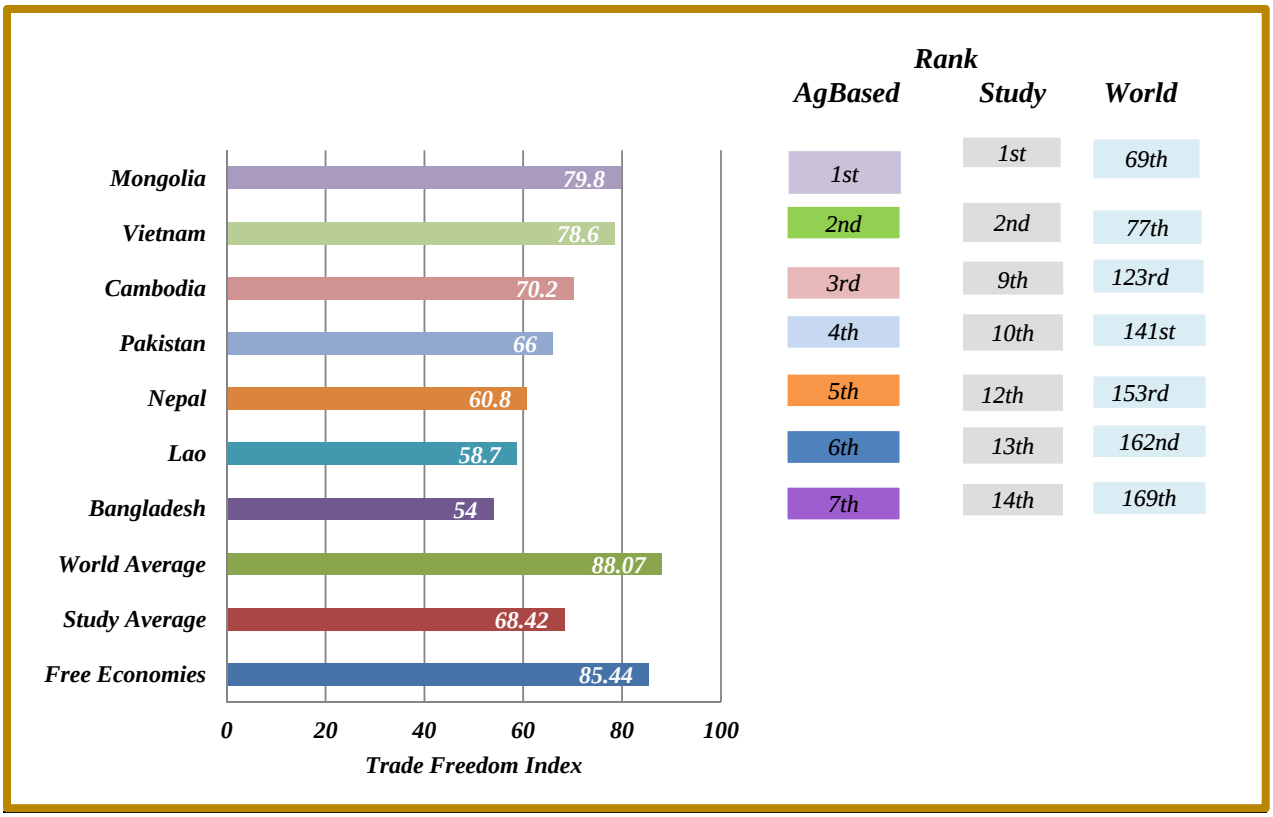

Figure 3.2. Agriculture-based Countries Comparison, 2013 Trade Freedom Index.

Although some tariffs have been reduced in Nepal, the trade-weighted average tariff rate remains high at 12.1 percent, and pervasive non-tariff barriers further restrict trade freedom. Hence, in 2013, Nepal ranks 153rd in the world trade freedom index and ranks 5th among the agriculture-based Asian countries under study. For both the agriculture-based and transforming Asian economies, it ranks 12th. Lao's trade freedom index is 58.7 in 2013, making its economy the 162nd in the world's ranking. This index was essentially the same as the previous year. Laos ranked 6th among the 7 agriculture-based countries and 13th among the agriculture-based and transforming economies under study and below the world average. The trade-weighted average tariff rate is burdensome at 13.2 percent and import licensing and customs delays further constrain trade freedom.

With a trade freedom index of 54.0 in 2013, Bangladesh ranks last among the agriculture-based Asian countries and 14th among the 15 countries under study. Various non-tariff barriers and the government's reliance on tariffs as a revenue source increase the cost of trade making it 169th in the world's ranking of trade freedom.

3.4.2.2. Transforming Asian Economies

Figure 3.3 graphs the trade freedom index of the transforming Asian countries under study from 1995-2013. The Asian Drivers – China and India – just recently opened their economies compared to other countries under study with most of the countries in the "mostly free" category (70-79.99 trade freedom indexes) beginning in the year 2000.

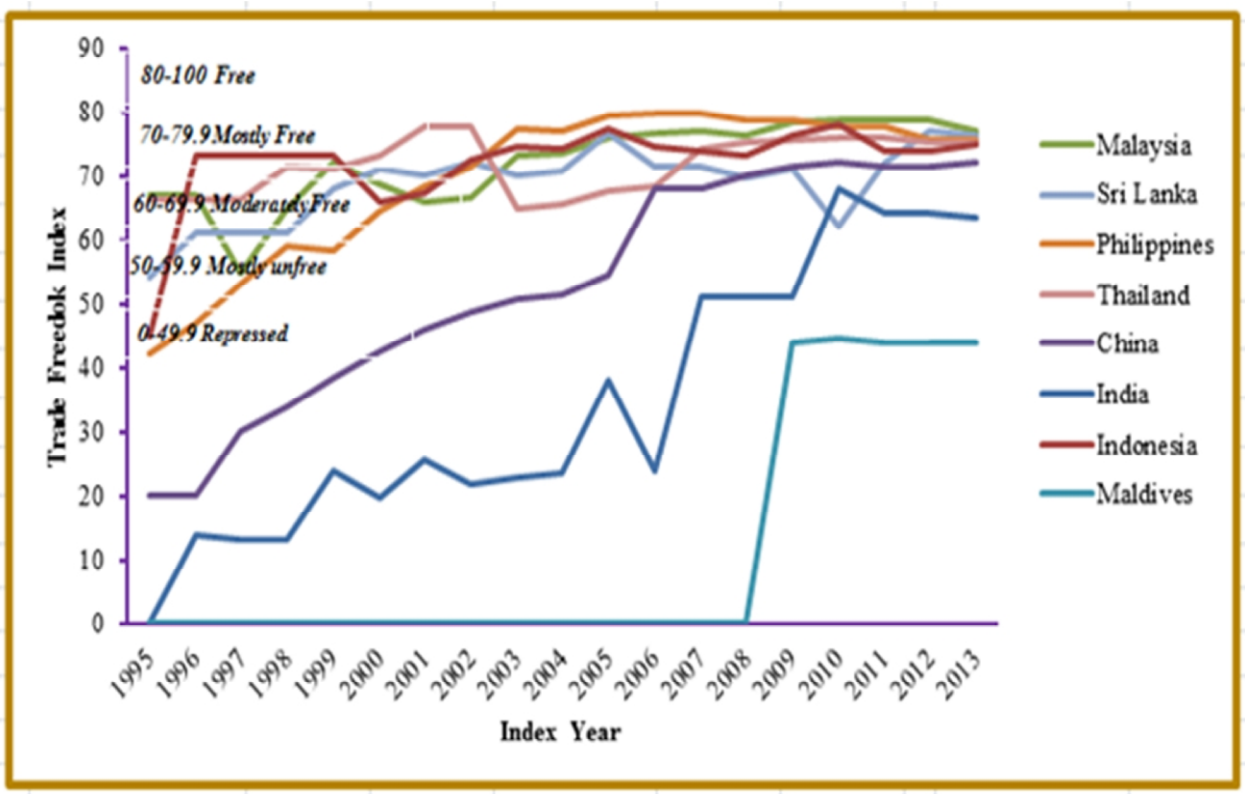

Figure 3.3. Trade Freedom Index: Transforming Asia, 1995-2013.

Figure 3.4 presents the trade freedom ranking of the Asian transforming economies under study in 2013. The average trade freedom index for this group is approximately 69.6 while for all countries under study (agriculture-based and transforming), the average is 68.4.

Malaysia ranks 1st among this group of countries, Sri Lanka ranks 2nd and so forth. Malaysia's trade freedom index is 77 making it the 88th in the world in 2013. Among the transforming economies, Maldives ranks last with an index of 43.7 and ranks 175th in the world. The government relies heavily on tariff revenues to fund its activities. The trade-weighted average tariff rate is prohibitively high at 20.6 percent, and non-tariff barriers add further to the cost of trade. China and India are ranked 116th and 147th, respectively, in the world, and both remain "mostly unfree." The trade-weighted average tariff rate of India remains a burdensome 8.2 percent, and complex nontariff barriers further impede trade while China's trade-weighted average tariff rate is 4 percent, and layers of non-tariff barriers add to the cost of trade.

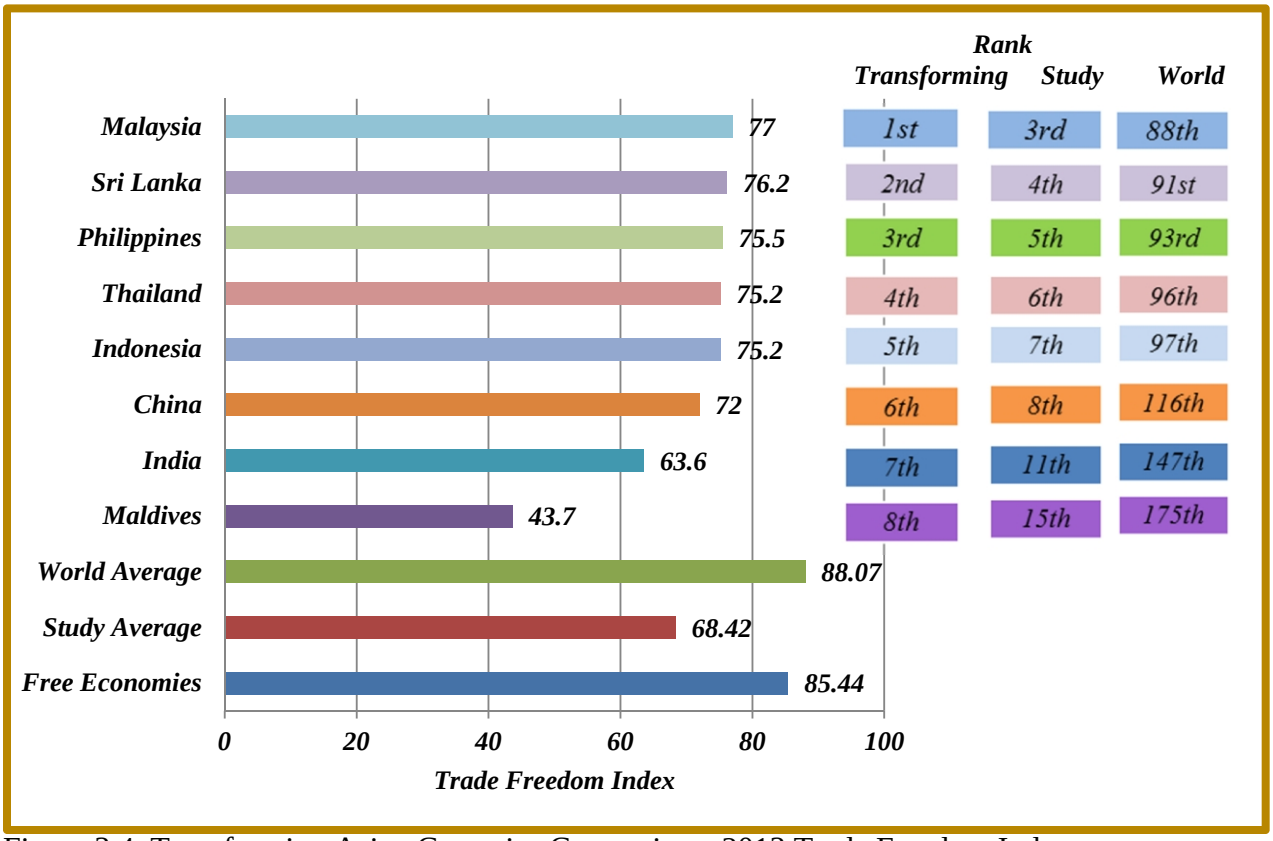

Figure 3.4. Transforming Asian Countries Comparison, 2013 Trade Freedom Index.

3.4.2.3. Trade Freedom Index of the Selected Developed Countries

To put the numbers of the trade freedom index in perspective, it is worth comparing the level of trade openness in the agriculture-based and transforming economies of Asia with the trade openness of urbanized countries such as Japan, South Korea, the European Union, and the United States as measured by the same index. The index for selected developed countries is illustrated in Figure 3.5.

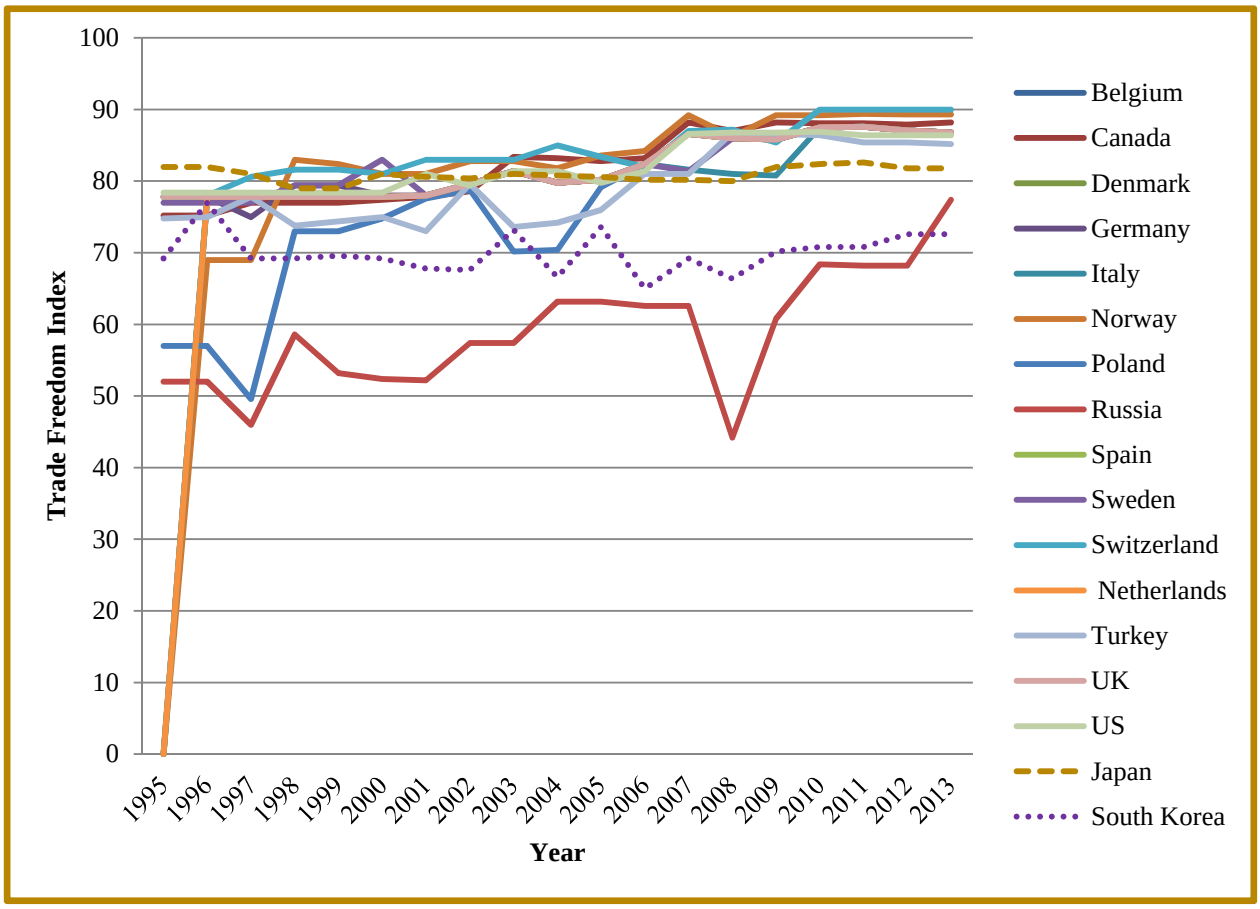

Figure 3.5. Trade Freedom Index, Selected Urbanized Countries, 1995-2013.

During the 1995-2013 periods, Japan was freer than South Korea with an average index of 81 against 70. The United States was among the countries that had the highest average index of 82 along with Canada, Germany, Spain, Sweden and UK. Russia had the lowest index of 59 among the countries in Europe randomly selected. As presented in the previous sections, the

average index for the countries under study was only 68.4, which is only "moderately free" while the urbanized countries are categorized as "free economies" since the early 2000s with the exception of some countries and were "mostly free" from 1995-1999.

3.4.2.4. Exports of Agriculture

Agriculture-Based Asia

On average, the agriculture sector of the agriculture-based Asian economies generated 15% of the value of total exports in 2010 (Figure 3.6). Except for Vietnam and Lao PDR, the steady decline in the share of agricultural exports in total exports is evident every decade since the 1960s to the extent that agricultural exports constituted no more than 15% by the 2000s. The agriculture of Cambodia and Nepal both contributed more than 90% in the 1960s. However, Cambodia declined to an average of 2% in the 2000s while Nepal declined to 20%. Vietnam's and Lao's agricultural share of exports are somewhat different from other countries in this group. In the 1960s, agricultural exports for these economies contributed on average around 20%; they decreased in the 1970s and recovered in the 1980s to a value higher than in the 1960s. Vietnam ended in the 2000s with a contribution of 12% while LAO PDR was only half that of Vietnam.

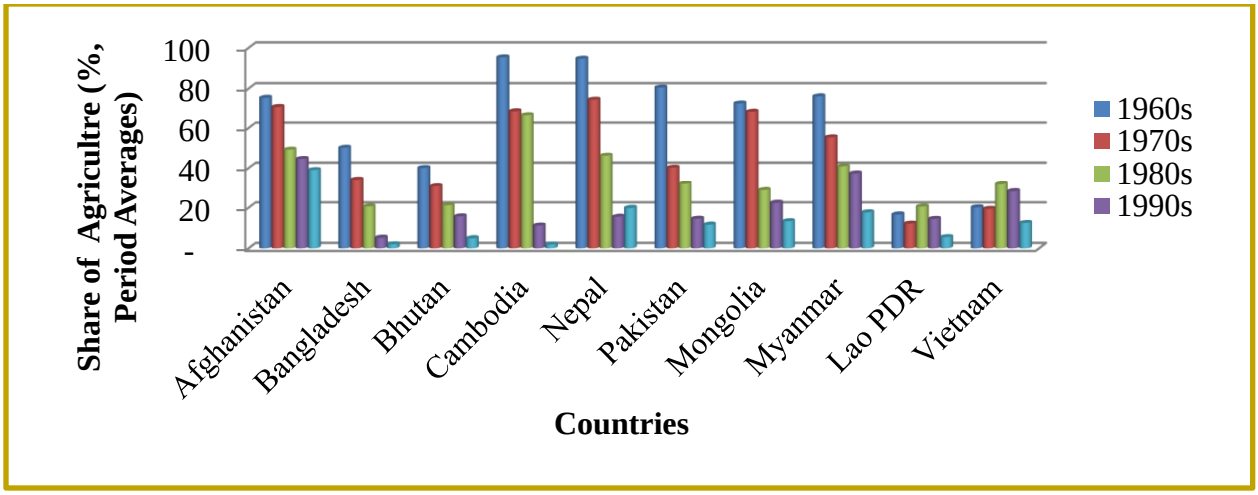

Figure 3.6. Share of Agriculture to Total Merchandise Exports of Agricultural-Based Countries, Period Averages (1961-2009).

Transforming Asia

On average, the agriculture sector of the transforming Asian economies generated 11.4% of the value of total exports in 2010 (Figure 3.7). The transforming economies share similarities on the trend of agricultural exports. The sector's share of agricultural products in total merchandise exports decreased to a historic low of less than 15% in the 2000s. During the 1960s, Sri Lanka had the highest share of agricultural exports for this group but it decreased from more than 90% to only 20% in the 2000s. The Asian drivers started in the 1960s with a contribution of 37% and 39% in China and India, respectively, and both contributed less than 10% in the 2000s. For the Philippines and Indonesia, this sector contributed around 60% in the 1960s. After four decades, Indonesian agriculture accounted for only 13% of total merchandise exports while the Philippines was even lower, registering an average of only 5%.

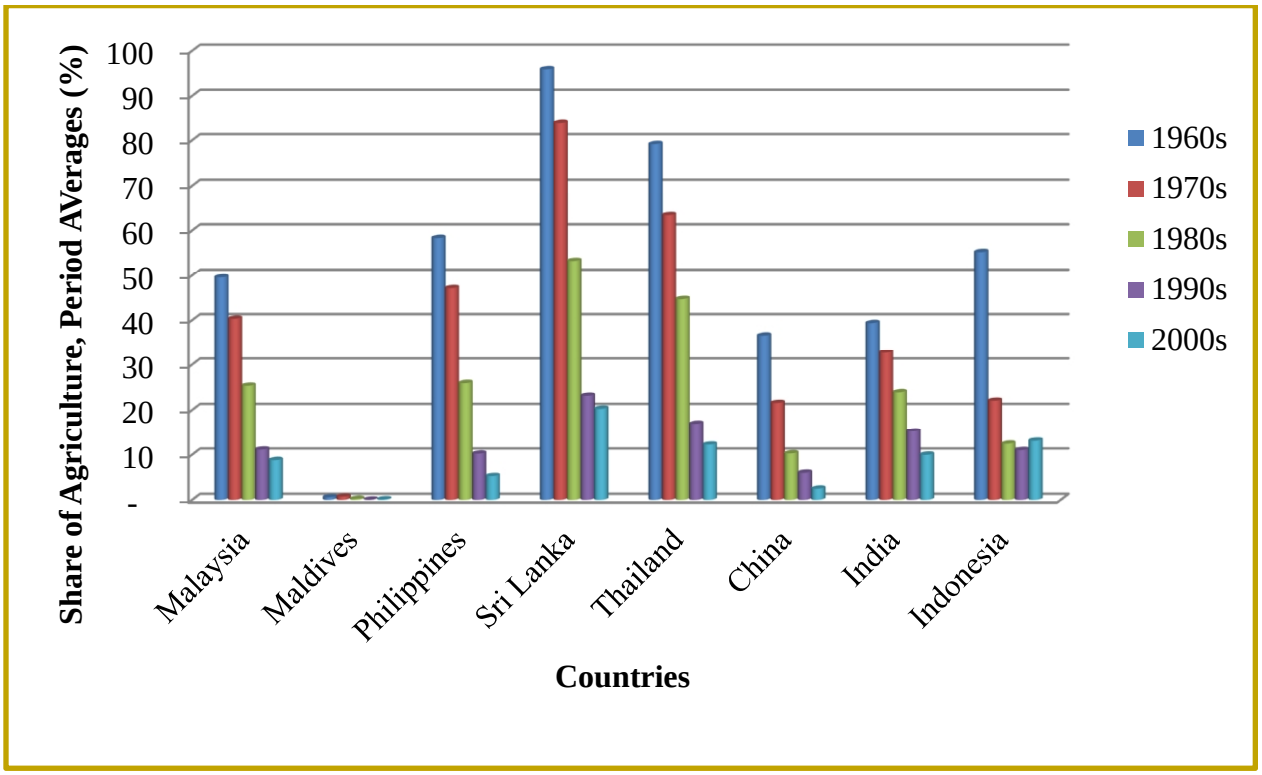

Figure 3.7. Share of Agriculture in Total Merchandise Exports, Transforming Asian Countries, 1961-2009, %.

Urbanized Asia

While the South Korean agricultural sector contributed 17% to merchandise exports during the 1960s, Japan contributed less than 2% and did not increase for the last four decades (Figure 3.8). In the 1970s, agricultural exports were only about 6% and continued to decrease thereafter. During the most recent decade, the constant decline caused this sector's contribution to exports to decrease to about 1% in the 2000s. In 2010, the average contribution of these two countries in agriculture to the total value of exports was only 0.62%.

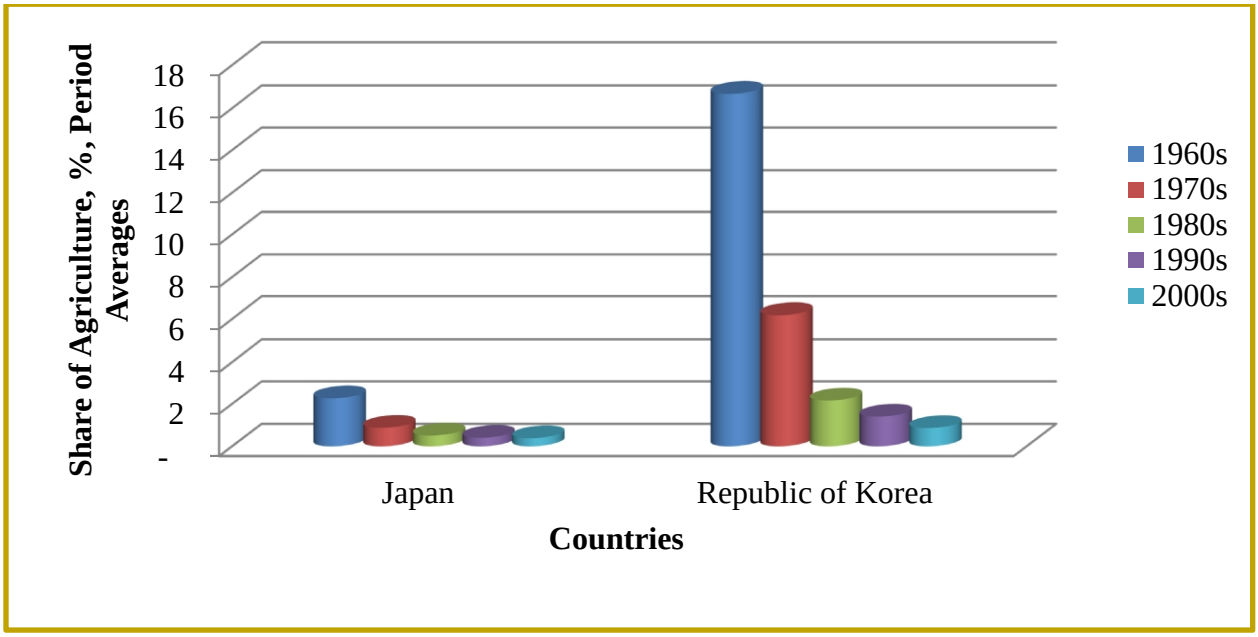

Figure 3.8. Share of Agriculture to Total Merchandise Exports in Urbanized Asia, %, 1961-2009.

3.4.3. Imports of Agricultural Products

3.4.3.1. Agriculture-based Countries

Within the agriculture-based countries under investigation, a variation on net exports could be observed. Pakistan and Bangladesh have generally been net importers of agricultural products since the 1960s (Figure 3.9) . The values of net imports increased year-over-year with the most recent year highest in Bangladesh. Vietnam used to be a net importer of agricultural products (from the 1960s to early 1980s) and since then became a net exporter until 2010 where

there is data available. Other agriculture-based Asian countries (Myanmar, Bhutan and Mongolia) were less dynamic than the rest of the group. However, Bhutan still recorded an excess of imports from 1960-2010, as did Myanmar and Mongolia. Nepal's export and import trend followed that of Bhutan, registering net imports during the same period.

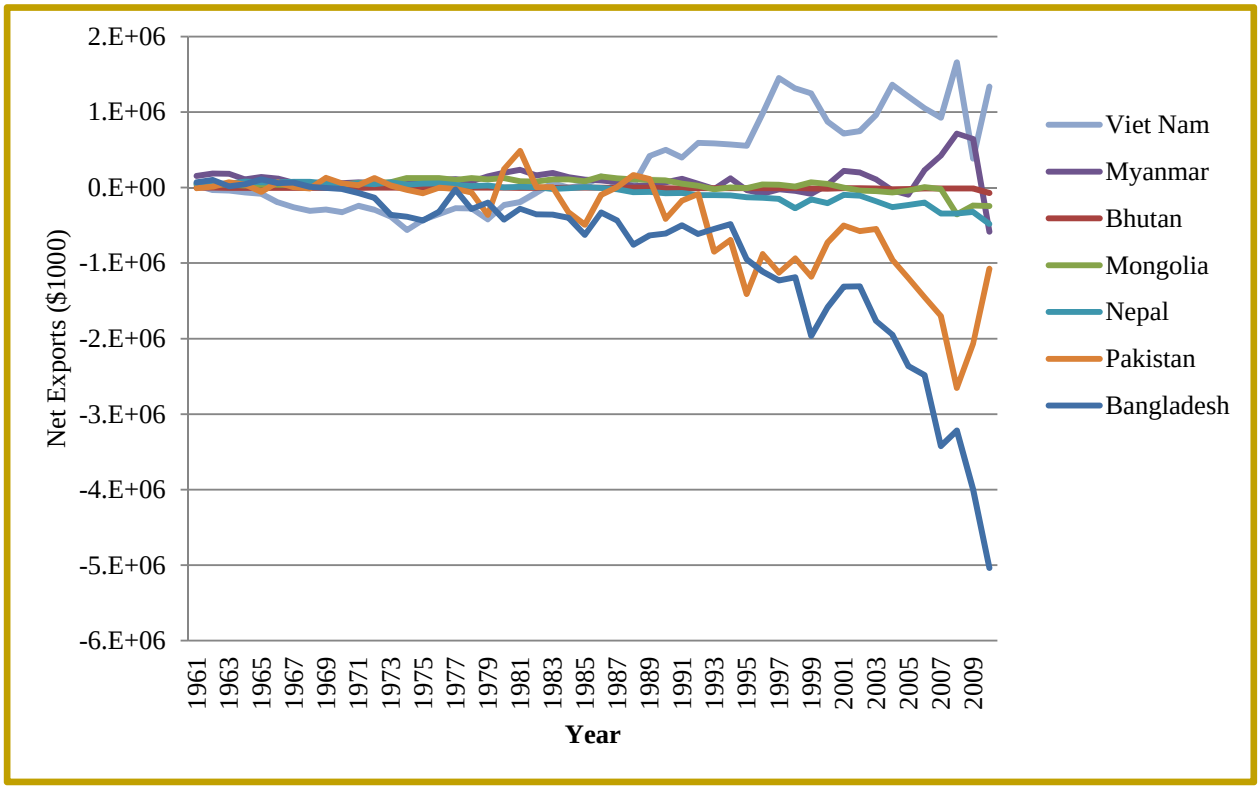

Figure 3.9. Agricultural Net Exports of Agriculture-Based Countries, 1960-2010.

3.4.3.2. Transforming Asia

For the transforming Asia, China registered increasing net imports of agricultural commodities since the middle of the 1990s and during some years in the 1970s (Figure 3.10). However, the other Asian driver, India, has been a net exporter in this sector since the early 1970s and continued to be the same until recently. Except for Maldives and the Philippines, the rest of the transforming Asian countries included in this study are net exporters of agricultural products with an upward trend.

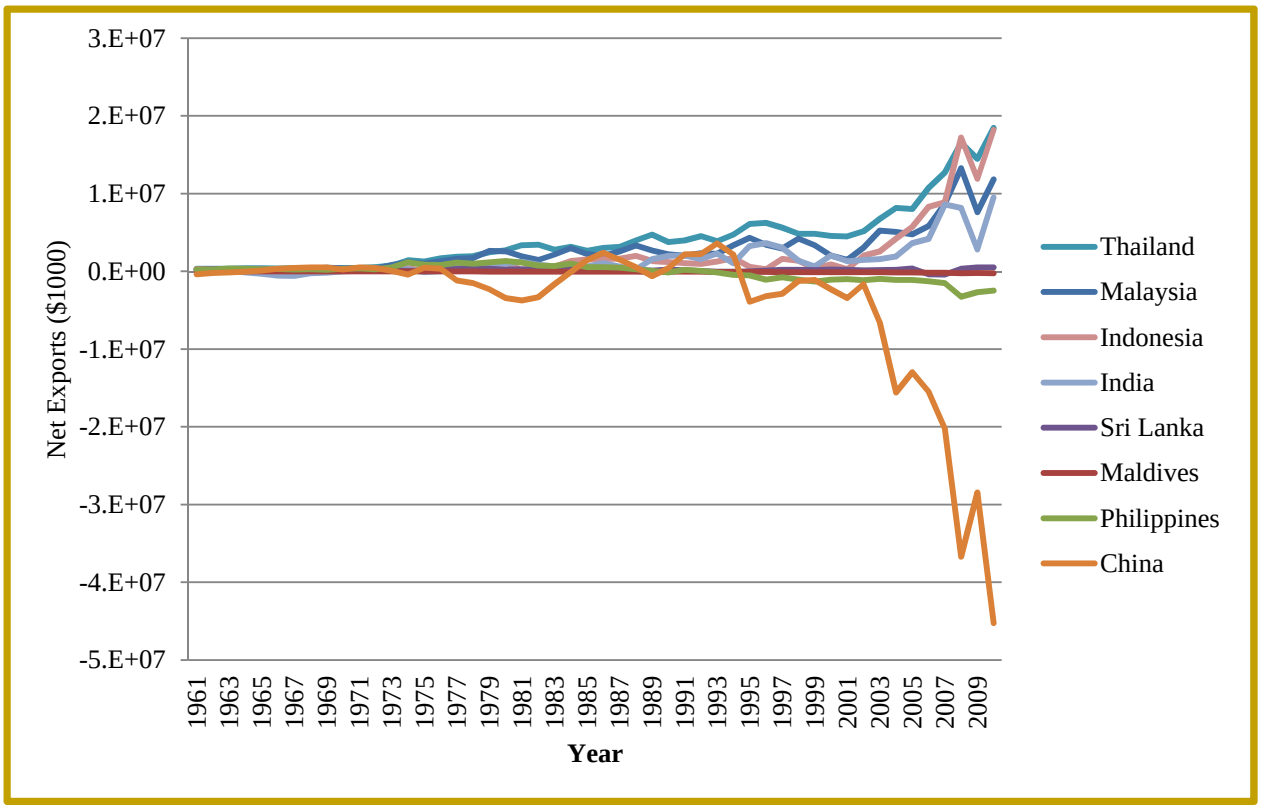

Figure 3.10. Agricultural Net Exports of Transforming Asian Countries, 1960-2010.

3.4.4. Analysis and Interpretation

This section details the results of the empirical investigation intended to determine whether the effect of agriculture on economic growth is dependent on the openness of the economy as argued by some in the literature.

3.4.4.1. Agriculture-based Countries

Table 3.2 presents the regression analysis on the effect of trade openness on the relationship between agriculture-value added per worker and GDP per capita. Column 4 is the impact of dummy variable WTO on the relationship by allowing it to interact with the agriculture-value added per worker in the equation (Model 1). The data on macroeconomic variables used to analyze the relationship is from the period 1960-2011 obtained from the World Bank. The interactive dummy variable takes the value of 1 starting the year that these economies joined the WTO and 0 during the years preceding its accession as reported by the WTO. The

result of the regression analysis on the relationship between agriculture and economic growth as impacted by trade openness using the trade freedom index (TI) is presented in Column 6 of the same Table 3.2. For Model 2, the period in the sample size started in the year 1995 where TI information was provided by the Heritage Foundation and ended in 2011 for most of the countries where the World Bank has the published values for the agriculture-value added per worker and GDP per capita. For both models, the independent variables are standardized by centering the mean (except the dummy variable). Mean-centering can reduce the covariance between the linear and the interaction terms, thereby reducing collinearity. All the variables are in levels transformed into the log values.

If trade openness affects the impact of agricultural productivity on per capita income negatively as hypothesized, then there would be a negative and statistically significant value as an estimate of the parameter coefficient of the interaction variable. Using Model 1, the coefficient of the explanatory interactive variable, D*AGR, has a statistically significant value with the expected negative sign (Table 3.2) for the country of Bangladesh. This implies that the positive impact of agricultural productivity on GDP per capita when Bangladesh opened its economy is slightly less than that of a closed economy. Further, the results show that a one percent increase in the agricultural productivity is associated with a 0.3350 percent increase in GDP per capita of a "closed" Bangladesh while it is only associated with a 0.2306 percent increase as it opens its economy (0.3350 less 0.1044). Using the trade freedom index to measure openness (Model 2), the effect of agricultural value added per worker to GDP per capita is 0.2230 percent as the agricultural productivity increases by 1 percent when it is a closed economy and this effect decreases to 0.2200 (0.2230 less 0.0003) percent as it opens up its economy to trade. However, the impact of openness to the relationship on agricultural

productivity and GDP is not significant when the trade freedom index is the measure of openness.

Table 3.2. The Impact of Trade Openness: Agriculture-based Asian Countries[20].

No.	Countries	Model 1		Model 2	
		AGR	D*AGR	AGR	TI*AGR
1	Bangladesh	0.3350***	-0.1044*	0.2230***	-0.00030
		(0.0356)	(0.0576)	(0.0564)	(0.00032)
2	Bhutan	N/A	N/A	N/A	N/A
3	Cambodia	0.1472	0.1772	0.2039	-0.0093
		(0.2256)	(0.3259)	(0.1210)	(0.0063)
4	Lao	N/A	N/A	-0.0035	-0.0035
				(0.0026)	(0.0026)
5	Mongolia	0.1520	-0.0575	0.0832	-0.0022
		(0.1164)	(0.1612)	(0.1440)	(0.0128)
6	Nepal	0.7742***	-0.3855	0.6837**	-0.0033
		(0.0971)	(0.3744)	(0.2745)	(0.0166)
7	Pakistan	0.1745***	0.1147	0.2898**	0.0011
		(0.0621)	(0.1196)	(0.1250)	(0.0084)
8	Vietnam	2.1730***	0.0634	2.1938***	0.0319***
		(0.1227)	(0.6808)	(0.1249)	(0.0083)

Standard errors in ( ). A "***", "**" and "*" indicate statistical significance at 1%, 5% and 10% level, respectively. Bhutan and Lao are still observers to the WTO, hence, there is no estimate for Model 1. Further, Bhutan has no estimate for Model 2 since data on TI is not available.

Vietnam is another country where trade openness affects the relationship between agriculture and economic growth in agriculture-based countries, but only when using the trade freedom index as a measure openness (Model 2). A one percent increase in the agricultural productivity is associated with a 2.1938 percent increase in GDP per capita of a "closed" Vietnam economy while it is associated with a 2.2257 (2.1938 plus 0.0319) percent increase as it opens its economy. This result is not as expected; that is, it is expected that openness would decrease the impact of agricultural productivity rather than increase as in this case. The impact of the relationship between agriculture and economic growth for the rest of the agriculture-based

[20] Diagnostic tests were conducted to validate the linear regression framework used in the analyses. The results are presented in Appendix 4.

countries investigated is not affected by both measures of trade openness. These are the economies of Cambodia and Mongolia.

3.4.4.2. Transforming Asian Countries

The result in Table 3.3 suggests that the impact of trade openness on the relationship between agriculture and economic growth in transforming Asian countries is significant for most of these countries (Model 1). Using the dummy variable of WTO accession to represent trade openness, there are five out of 8 countries that this interaction variable is significant. These are the countries of China, India, Malaysia, Philippines and Thailand. Except for Malaysia, the effect of the trade openness is as hypothesized – the agricultural productivity's impact on GDP capita will decrease as a result of openness. Using the trade freedom index to measure trade openness, the number of countries decreases to only two - India and Thailand.

In the case of China, a one percent increase in agricultural productivity causes GDP per capita to rise by 2.6029 percent before China joined WTO, but this impact decreases to 2.1942 percent (2.6029 -0.4087= 2.1942) as a result of joining the WTO. However, using the trade freedom as a measure of openness, its impact on the relationship is no longer significant, though the sign is still as expected (-0.0020).

India is the case where the hypothesis that the openness of a country affects the relationship of agricultural productivity to economic growth is supported in both models. Nevertheless, the evidence is conflicting. Using the dummy variable to model the effect of trade openness (Model 1), the effect is a decrease in the impact of agricultural productivity to GDP from 2.5996 percent to 2.1971 percent as India joined WTO. Employing the trade freedom index to measure trade openness, the impact of agriculture slightly increases from 0.7915 to 0.8028 percent (0.7915 + 0.0113 = 80.28).

Table 3.3. The Impact of Trade Openness: Transforming Asian Countries[21].

No.	Countries	Model 1		Model 2	
		AGR	D*AGR	AGR	TI*AGR
1	China	2.6029***	-0.4087**	2.0278***	-0.0020
		(0.0821)	(0.1874)	(0.1634)	(0.0033)
2	India	2.5996***	-0.4025**	0.7915***	0.0113**
		(0.0811)	(0.1858)	(0.0669)	(0.0022)
3	Indonesia	0.4205	0.9126	1.2006***	-0.00444
		(0.3903)	(0.6431)	(0.1576)	(0.0285)
4	Malaysia	0.1611	1.0403**	0.8143***	-0.0139
		(0.2627)	(0.4131)	(0.0722)	(0.0087)
5	Maldives	0.1557	-0.0603	0.1569**	0.0037
		(0.1122)	(0.1558)	(0.0602)	(0.0029)
6	Philippines	1.5715***	-0.6716**	0.6122***	0.0154
		(0.2944)	(0.3078)	(0.1576)	(0.0139)
7	Sri Lanka	0.2371**	-0.0147	0.7685**	0.0128
		(0.0965)	(0.1451)	(0.3019)	(0.0228)
8	Thailand	3.0855***	-2.2215***	0.8909***	0.0764**
		(0.3135)	(0.3607)	(0.0753)	(0.0184)

Standard errors in ( ). A "***", "**" and "*" indicate statistical significance at 1%, 5% and 10% level, respectively.

Examining Malaysia, the effect of the accession to the WTO on the relationship of agricultural productivity and economic growth is positive increasing agriculture's contribution to economic growth by 1.2014 percent from 0.1611 percent before the country joined WTO, which is not as expected. However, using the trade freedom index, the sign of the effect of the interaction variable is as expected but no longer significant.

The Philippines is another case where the accession to the WTO causes the contribution of agriculture to GDP to decrease as expected. However, using the trade freedom index no significant effect can be found. Before the accession to WTO, a 1 percent increase in agricultural productivity in the Philippines will result to 1.5715 percent increase in GDP per capita.

[21] Diagnostic tests were conducted to validate the linear regression framework used in the analyses. The results are presented in Appendix 5.

However, after joining the WTO, this effect decreased by 0.6716 percent, resulting in 0.8999 percent as the agriculture's contribution to GDP after the WTO accession.

The result of the empirical investigation of the Thailand economy is similar to the Indian economy. While both measures of trade openness significantly impact agriculture's contribution to GDP per capita in Thailand, the effect is conflicting. Using the dummy variable, the result is as expected but an opposite sign of the interaction variable is obtained from the trade freedom index. The accession to WTO causes agriculture's impact to GDP to decrease from 3.0855 to 0.8640 percent (3.0855-2.2215=0.8640). Using the trade freedom index, the result is an increase from 0.8909 to 0.9673 percent. The remaining transforming Asian countries do not show evidence that the impact of agriculture to economic growth is dependent on the openness of a country. These are the countries of Indonesia, Maldives and Sri Lanka.

3.5. Conclusion and Policy Implications

The results of the empirical investigation to determine whether the relationship between agriculture and overall economic growth is affected by the openness of a country, as predicted by some authors in the literature, suggests that this idea is only partially consistent with the evidence from the agriculture-based and transforming economies. As hypothesized, the openness of some economies under investigation negatively affects the gains in the economic growth from improvement in the agricultural productivity. For other countries, the impact of openness is not strong enough to cause a negative relationship between economic growth and agricultural productivity. Further, the effect does not bring large differences in the gains from agricultural productivity between the open and closed economies in most of the countries under investigation using the trade freedom index but is more supported when using the WTO accession as a dummy variable.

Based on the results of this study, it is important to develop appropriate policy prescriptions, depending on whether agriculture is the engine of growth and how openness affects agriculture's contribution to economic growth. For instance, for countries at the low end of transformation process (i.e., agriculture-based) such as Bangladesh, where liberalization adversely affects agriculture's contribution to growth, development strategy could rely on protectionist policies during the early stages of the industrialization process. If agriculture is the country's engine of growth during the agriculture-based stage of development, policies that reduce the negative impact of openness could be established (e.g., agriculture protection may be required for a successful economic development). Almost all developed countries, including Britain and the U.S. relied on protectionist policies during the early stages of industrialization (Chang, 2002; 2009). Hence, developing countries of today may be allowed to use similar protectionist policies in order to possibly attain industrialization and catch up with the developed world. As argued by Gonzales (2002, 2006), "leveling the playing field (liberalizing equally both in developed and developing countries)" would perpetuate economic advantages in the agricultural sector that the developed world has gained as a consequence of "decades of agricultural protectionism and centuries of colonialism". On the other hand, for countries such as Vietnam whose agriculture's contribution to overall economic growth is significantly affected in a positive manner, agricultural protection may not be the best development strategy as this could mean a disadvantageous policy for most of rural household.

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CHAPTER 4: FOLLOWING THE EVOLUTIONARY PATH OF SOUTH KOREA: A SPECIAL EMPIRICAL INVESTIGATION ON HOW AGRICULTURE CONTRIBUTES TO ITS URBANIZATION

4.1. Introduction

South Korea exemplifies the successful urbanized economy. Within four decades following the end of Japanese colonization in 1945, it transformed itself from a predominantly agrarian to a predominantly industrial society (Chang and Lee, 2006). Today, Korea is the world leader in electronics, telecommunications, automobile production, and shipbuilding and the world's 15th largest economy that has enjoyed decades of impressive economic growth (Miller *et al*., 2013).

In 1960, the gross national income (GNI) per capita measured in constant 2005 US dollars was only $1,486 (World Bank, 2013). The country's exports of goods and services during the same period were immaterial to the economy, amounting to only US$ 219 million. Despite these poor initial conditions, Korea achieved remarkable economic development between 1960 and 2012. Korea's real GNI per capita increased phenomenally to US$ 21,674 in 2012, with an average growth rate of 5.36 percent per annum. This rise in GNI per capita was accompanied by a fast-growing export industry that increased to US$ 549 billion in 2012, a value that represents 56.50% of the gross domestic product (GDP), which, in 1960, was a mere 3.16%.

From the mid-1960s to the late 1970s, Korea was an agriculture-based *economy*. Its agricultural workforce declined from 68.5% of the total workforce in 1960 to 34% in 1980 to 6.6 % in 2010, a rough measure of how Korea has been urbanized in a little more than a generation. Since the 1960s, Lee and Kim *et al*., (2010) reported that Korea began to change from a poor agrarian economy with surplus labor to an export-oriented economy, specializing first in labor-intensive manufacturing and later in capital- and skill-intensive manufacturing as its factor

endowments shifted to capital and skill accumulation. As the share of agriculture steadily declined, Korea transitioned to a transforming economy beginning in 1980 and by 1993, Korea joined the rank of the urbanized economies and continued to be until the present. These classifications are based on 2008 World Bank's Development Report.

The rise of the Korean economy has been documented in a great volume of literature. Francks, Boestel and Choo-Hyop (2006) analyze agriculture's contribution to the East Asian model of development and provide reasons behind the dramatic rise in agricultural protection. The authors noted that there was only little attention paid to the role of the agricultural sector, either in the 'miracle' industrialization of the region, which includes, Korea, or in the political economy of the mature industrial economies that have now emerged. In addition, the available literature on the role of agriculture in the Korean economy has different views on how agriculture helps in Korean urbanization, similar to the literature on the role of agriculture to economic progress in other countries.

As Korea evolved rapidly from a predominantly agrarian society to the predominantly industrial economy, what was the role of agriculture in this unusually rapid economic growth? How and to what extent did agriculture contribute to South Korean economic growth as the country evolved from an agricultural-based to a nonagricultural-based economy? What changes were expected to occur in the process, and how does this compare with observable data? The World Bank (2008) argues that in agriculture-based countries, agriculture can be the main engine of economic growth. It is less important in transforming economies, but still instrumental in reducing rural poverty. Agriculture plays the same role as other tradable sectors and subsectors with a comparative advantage in stimulating economic growth in urbanized countries of the world.

This chapter investigates the role that agriculture has played in Korea, in theory, as argued in the 2008 World Bank development report testing empirically using observable data. Hence, it contributes to the ongoing debate on the role of agriculture in the economic transformation of Korea. This chapter follows the Korean evolutionary path from one country type to another and investigates empirically how agriculture contributed to Korean industrialization. The Korean economy is chosen for two reasons. First, the economy of South Korea has been distinguished since the mid-1960s by spectacular economic growth. In recent decades, such growth has been studied extensively as a successful case of economic development. Second, there is a prevailing view that Korean industrialization did not precede the agricultural revolution.

The remainder of this chapter is structured as follows. In Section 2, a review of the literature on the relationship between agriculture and economic growth is provided followed by an overview of the Korean economy in Section 3. The empirical method, variables and data used in assessing agriculture's contribution in moving from a predominantly agricultural to the urbanized Korean economy is presented in Section 4. The empirical results are summarized in Section 5 with a corresponding economic explanation of the findings. Conclusions and policy implications are provided in the final section.

4.2. Review of Literature

Like the literature on the role of agriculture in economic development in other countries, there are differing views in the case of Korea. In this section, the possible extent and nature of the role of agriculture in the economic success of Korea is considered as well as the various aspects of agriculture's part in the industrialization process. It further presents the opposing views in the literature on how agriculture contributes to economic development in Korea,

including some evidence of industrialization without any preceding agricultural revolution. Other possible causes and origins of the so-called Korean "economic miracle" as an alternative explanation to Korean economic growth are also discussed.

The assessment surrounding the causes of Korea's rapid growth could be divided into two schools of thought, namely: neoclassical and statist (Pinkston, 2007). The neoclassical school argues that Korea sustained high economic growth rates because the government provided macroeconomic stability and adequate incentives for Koreans to save and invest. The statist school, on the other hand, argues that "information problems, risk, and late entry limit or restricted development, and that only by "getting the prices wrong" through government intervention will firms engage in the activities necessary to trigger sustained economic growth".

Pinkston (2007) continues to cite that the Korean stabilization plan that included fiscal restraint, a devaluation of the won in 1964, and a sharp increase in interest rates in 1965 created an environment for South Korea's sustained economic growth based on a comparative advantage in labor-intensive manufactured goods. Most scholars who supported the neoclassical interpretation also acknowledge the widespread market intervention in Korea, but they discount its effectiveness. The statist, on the other hand, argued that in the 1960s, South Korea represented a "strong state" insulated from particularistic societal demands that was able to accelerate growth through a coherent economic development strategy. Both of these interpretations place strong emphasis on the industrial sector, whether through market means of resource allocation to export oriented manufacturing or because of state direction.

These approaches imply that Korea was able to bypass the traditional economic development path, which requires an increase in agricultural productivity to provide capital and labor for the industrial sector, because the Korean government established an institutional setting

for industrialization and the subsequent allocation of scarce resources to industrial firms (Pinkston, 2007). The author then argues that these views misrepresent the actual course of economic policy in South Korea during the transition to rapid growth and thus misunderstand the political economy of reform in the country as well. The Korean government under Park Chung Hee initially implemented a traditional economic development plan that targeted the agricultural and livestock sectors to accumulate foreign exchange and surplus capital and labor for the industrial sector. The state implemented a set of policy incentives for export-led growth that applied to *all* sectors, including agriculture and livestock. Moreover, the Korean government initially *targeted* agricultural and livestock products for export promotion, in line with what a simple political-economic analysis of policy in an overwhelmingly rural society would predict.

Korean agriculture played a limited role in industrialization compared to Japan and Taiwan (Francks *et al.*, 2006). It was the growth of the industrial sector that led the transformation of the economy in a classic, Lewisian-style, two-sector growth sequence based on the movement of surplus labor from agriculture to industry. Agricultural output grew, but only in response to the increase in the demand for food in the urban centers where industrial growth was concentrated. Rural households gave up their sons and daughters to the cities, but in other respects, intersectoral linkages were few, and the industrial sector grew based on capital generated within it or borrowed from abroad. Nevertheless, what happened in agriculture did continue to affect the extent to which industrialization goals could be achieved, via price of food and the supply to urban areas, and the migration of the rural population into the urban industrial workforce. Hence, the Korean government intervened to keep urban food costs and wages low (Bello and Rosenfeld 1992); and that agricultural output continued to grow, because of appropriate, yield-increasing technical change. The Korean government found itself unable to

ignore agriculture and proceeded to set up mechanisms for state intervention in agricultural production and in the agricultural markets which in many respects resemble their counterparts in Japan and Taiwan (Francks *et al.,* 2006), despite the rather different context in which they began to operate. Land reform for example, was a major factor in getting the country's industrialization started (Kay, 2002). Kay concludes that agrarian reform took place before any significant industrialization had taken place and was a key ingredient in the subsequent successful industrialization process. In conclusion, the structural transformation from a predominantly agricultural to a predominantly industrial economy occurred in Korea as it had done in the West, but within an unprecedented compressed time scale, transforming from a very poor country in the late 1950s to an industrial one by the late 1980s (Francks *et al.,* 2006).

Kang and Ramachandran (1999) by constructing a database that covers agricultural development during the period of Korea's annexation by the Japanese empire believe that there were several investments done in agriculture before the occurrence of industrialization. Their analysis is based on estimates of economic returns to investment in Japan during the colonial era before the industrial take-off. As Japan colonized Korea in 1910, investment in agriculture resulted in a growing food supply. These investments were in the form of irrigation and rural infrastructure, increased use of chemical fertilizers and high-yielding seed varieties. This was the direct result of the Japanese colonial policy to modernize Korean agriculture.

Furthermore, Mason *et al.,* (1980) reports that government expenditures on agriculture, forestry and fisheries more than tripled in real terms between 1963 and 1975, growing faster than GNP, and government investment and loans to these sectors represented about one-quarter of the government's total investment and loans. Teranishi (1997) continued that the Korean government did more in rural areas than the governments of the majority of developing

countries, in terms of investment in irrigation development, roads, electricity provision and sanitation.

However, Amsden (1989) argued that the case of Korea is one of the evidence of industrialization without preceding any agricultural revolution. That is, Korea attained growth without the need for agriculture-based development. Focusing on the periods during accelerated economic growth (1945-1975), Ban, Moon and Perkins (1980) argued that "There were no substantial net flows of savings or tax dollars from the rural to the urban sector. For the most part however, it was agriculture that benefited from the industrial and export boom rather than reverse." Farmers benefited through expanding urban demand and access to lucrative rural non-farm and urban jobs.

Korean agriculture contributed to industrial growth through well-educated and mobile workers, while agricultural output continued to grow at an adequate rate to meet much of the expansion in the domestic demand for food. Agriculture's labor contribution was achieved through the rural-urban migration, when dualism emerged as a significant issue only relatively briefly in the late 1960s. Therefore, government policy might have played a role in facilitating agriculture's contribution to industrialization.

The broad macro trends (decline in agriculture's share of income and employment, increasing agricultural import competition, pressure on the relative incomes of farmers) followed the same pattern as elsewhere in the industrial world but compressed it into a shorter time-scale. However, the responses of farm households and policy-makers did not result in a shift away from the pattern of small-scale cultivation centered on rice. Mechanization and some diversification took place, but the persistence of the small-scale farm unit implied that support for the

agricultural sector in the face of industrial growth meant support for household-based farming and the rice cultivation that was central to it (Francks *et al.*, 2006).

The following describes in detail some of the features of the Korean economy as it transitioned from a predominantly agricultural-based economy to an urbanized economy.

4.3. Overview of the Korean Economy: From Agriculture-based to Urbanized Korea[22]

4.3.1. Korean Agriculture

4.3.1.1. Agriculture's Share in GDP

Figure 4.1 presents the three worlds of agriculture in the Korean economy using available data from 1965-2011. In four decades, agriculture's share of GDP declined very rapidly. During the agriculture-based Korea (1965-1979), the agricultural sector accounted for about 30% of overall GDP where at the beginning of this stage, it contributed 39.4% to the total GDP and decreased to 20.9% in 1979. Korea became a transforming country in 1980 and continued until 1992 where agriculture was only 7.7% of the GDP. Agriculture started to contribute only less than 7% in 1993 and this value continued to decrease, reaching only 2.7% in 2011.

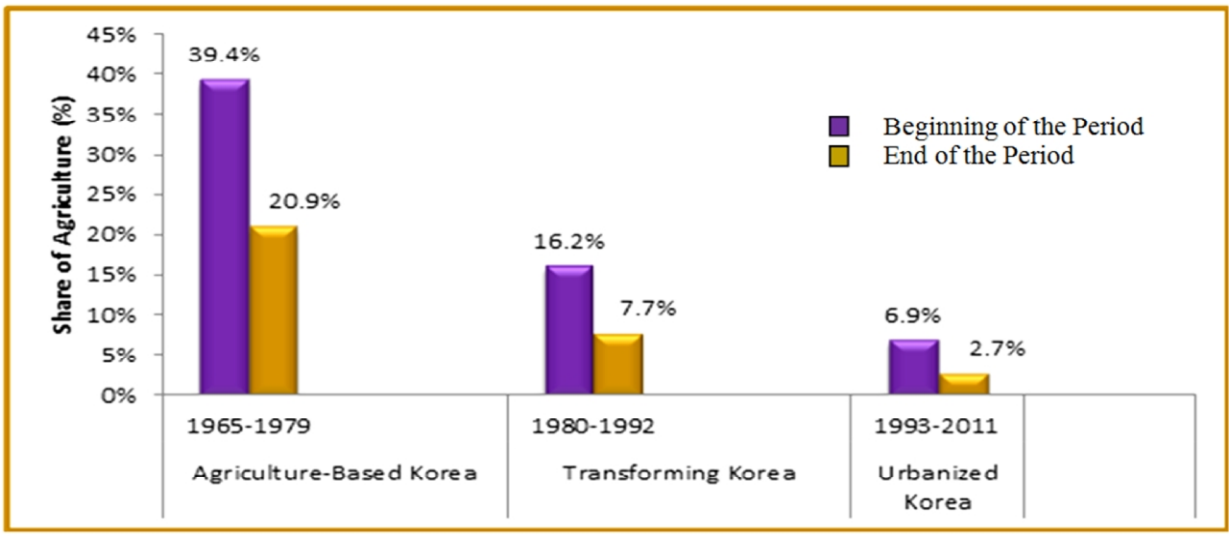


Figure 4.1. Share of Korean Agriculture to Economic Growth, Beginning and End of the Period, 1965-2011.

[22] Unless otherwise stated, the source of data presented in the graphs in this section is World Bank (2013).

4.3.1.2. Growth in Agriculture Value Added

Figure 4.2 presents the agriculture-value added per worker of Korea from 1980-2011 while Figure 4.3 presents its growth by the worlds of agriculture. As can be seen in the graph, Korea experienced increasing agricultural productivity from the 1980s. Francks *et al.*, (2006), however, pointed out that the source of increasing agricultural productivity lies in the increases in the current capital inputs, and on the improvements in technology such as fertilizer. Public investment in agricultural research and rural infrastructure development is another factor that influences the level of agricultural productivity.

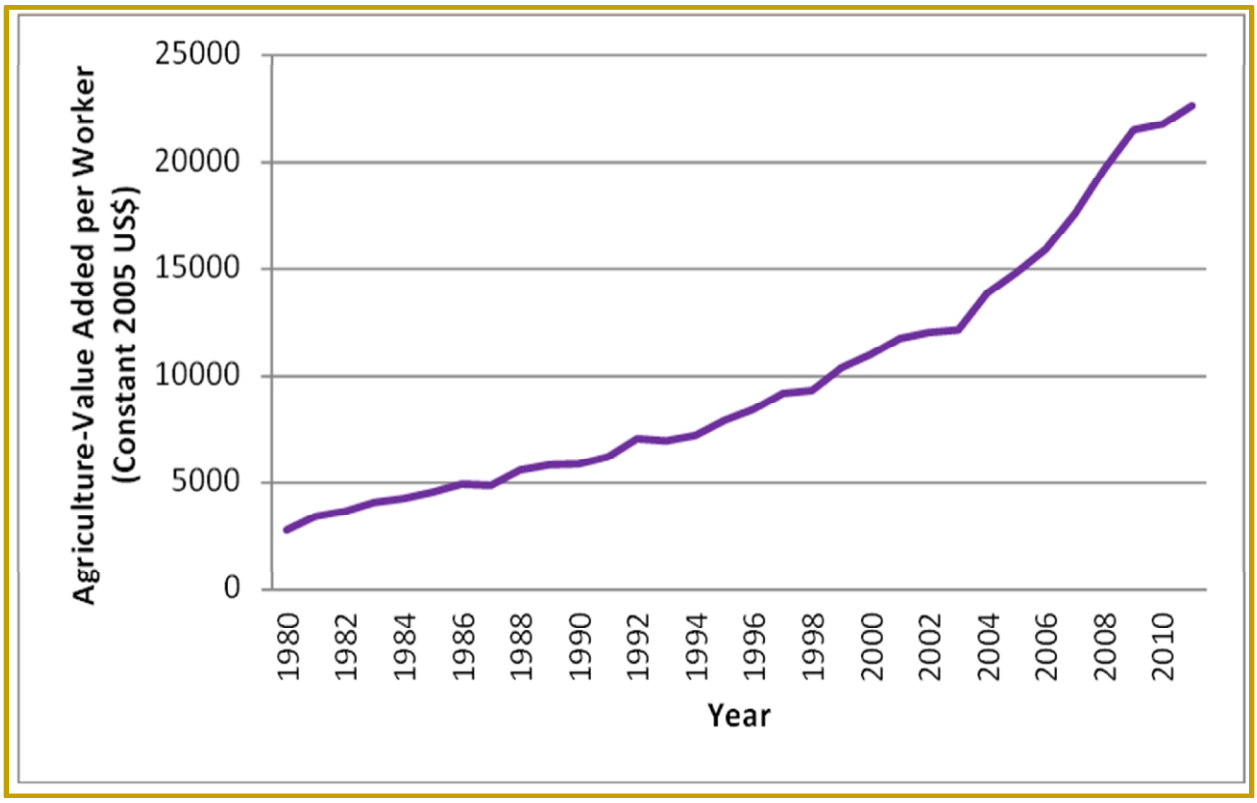


Figure 4.2. Korean Agriculture Value Added per worker (constant 2005US$):1980-2011.

In spite of an increasing agricultural productivity, Korea's growth was not impressive (Figure 4.3). Though growth was observed during the agriculture-based period, a drop in its productivity was registered in 1980 (-19.4%), the beginning of a transforming Korea; this

transformation can be attributed to the government's Heavy industrial and Chemical Industrialization in 1973-79, consequently transferring resources to the manufacturing sector.

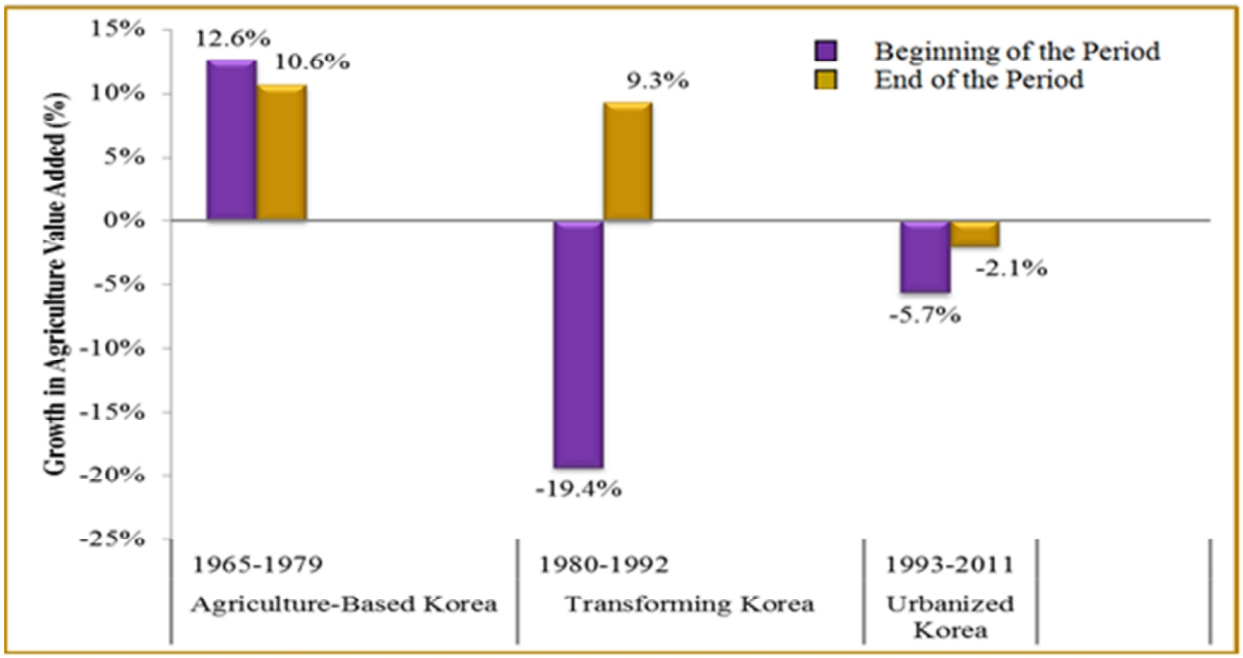


Figure 4.3. Growth in Agriculture Value Added, Beginning and End of each Period.

Agricultural productivity recovered at the end of the transforming period (1992), perhaps due to the government's establishment of institutional structure for intervention in agricultural production and markets in order to achieve output growth and greater national self-sufficiency in food. This was in the form of increasing shelter from foreign competition (Honma and Hayami, 1987). However, as the potential for yield increases through intensive application of labor and fertilizer was exhausted and output increases through improvements in labor productivity proved much harder to achieve, the urbanized Korea registered again a series of negative growth.

The nonagricultural sector has experienced more rapid growth than the agricultural sector as reported by Chowdhury and Islam (1993). Therefore, although the agricultural sector was by no means stagnant during the period of rapid industrial growth, it did not contribute a great deal to the overall growth of GDP (Francks *et al.*, 2006). The growth in the non-agricultural sector occurred when South Korea changed its exporting policies by reducing industrial protection and

encouraging exports of labor to the world markets, building up the export infrastructure and introducing exchange rates that are more realistic.

4.3.1.3. Employment in Agriculture

The labor input for agricultural production had been declining since the 1960 as Korea underwent rapid economic growth. It was an agrarian economy around 1960 with about 68.3 per cent of the work force depending on agriculture, forestry and fisheries for their livelihood and only 1.5 percent on manufacturing (Chaudhuri, 1996). As Korea moved to a transforming economy in 1980-1992, the agricultural sector on average accounted for only 24.45 percent of the total employment (Figure 4.4) and even less from 1992-2012 (9.92%) as the country became an urbanized economy. However, as the agricultural labor force continued to decline, productivity continued to increase as previously mentioned.

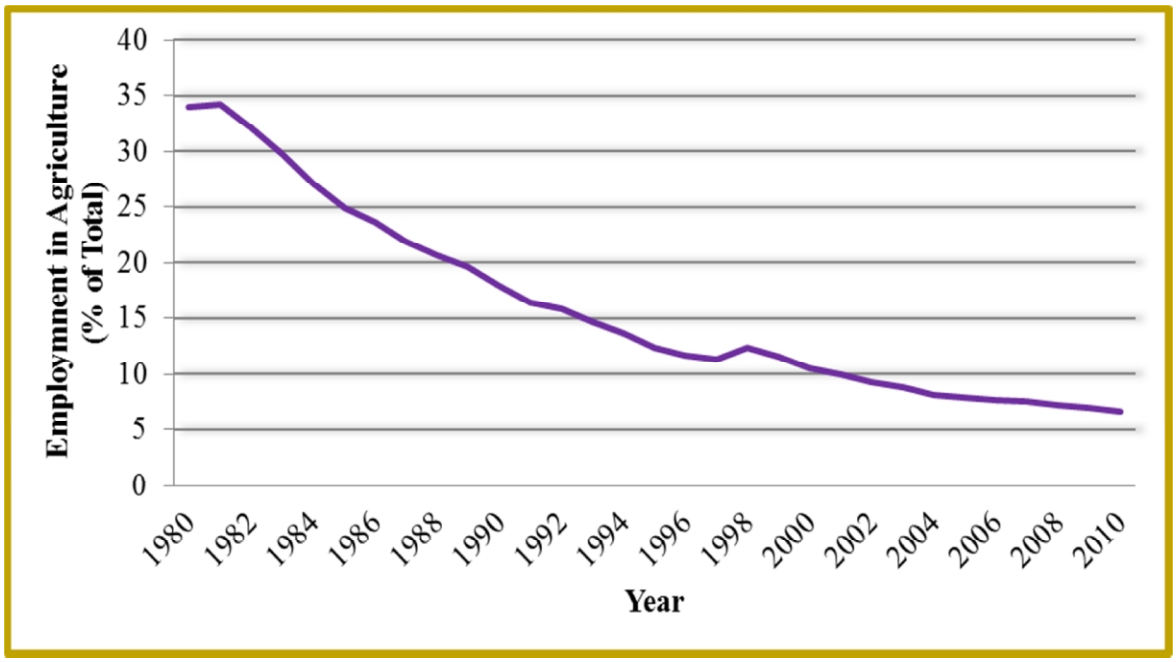


Figure 4.4. Korea's Employment in Agriculture, 1980-2011.

The dramatic shift in the employment structure towards industry and away from agriculture was due to the rapid growth of industrial production in Korea; even with the increase in the non-agricultural labor force, the result of population increases was due to migration from

farm households, which in the Korean case, was largely synonymous with rural-urban migration (Francks *et al.*, 2006). Therefore, agriculture's main contribution to industrialization consisted of labor and the large-scale movement of the population brought about by industrial growth, which was the important factor conditioning agricultural development through the 1960s and 1970s.

Economist W. Arthur Lewis argued that countries such as South Korea have a large traditional sector with vast amounts of "surplus labor" beside a small modern sector that participate in the economic growth development in the early stages. The surplus labor has created two effects. First, the flow of labor from the countryside enables the country to invest heavily in factories without running into diminishing returns. Second, the surplus army labor reserved competition kept the wages low despite the growth of the economy (Sicat, 2013).

4.3.1.4. Agriculture's Share in Total Exports

As an agriculture-based Korea, the agricultural sector contributed 17% to merchandise exports during the 1960s and to only 3% by the end of 1970s (Figure 4.5). As manufactured exports became more dominant during the 1980s, agricultural exports were only about 4% when the country transitioned to a transforming economy. As Korea became an urbanized economy in 1993, the constant decline caused this sector's contribution to exports to be only about 1%. This falling agriculture share in exports could be an indication of the rapid loss of comparative advantage in agriculture as manufactured exports became more dominant.

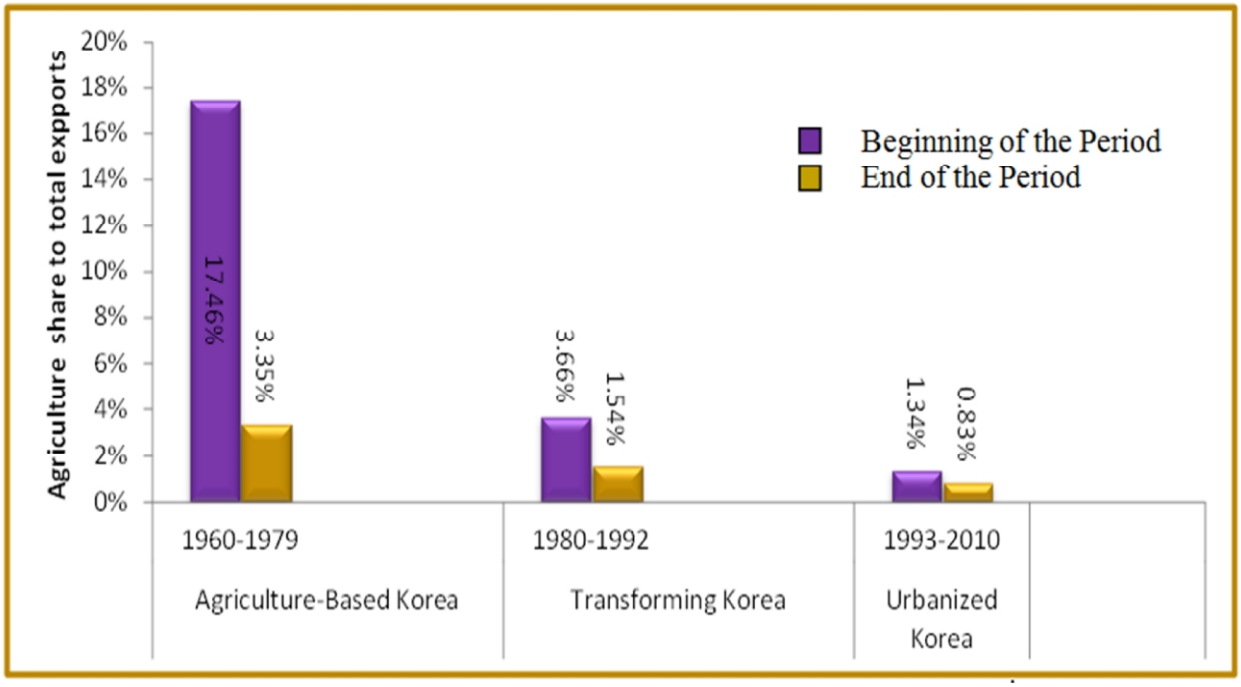


Figure 4.5. Share of Agriculture to Total Merchandise Exports of Korea, Beginning and End of Period (%).

4.3.1.5 Korean Imports of Agricultural Products

Since industrialization took place in South Korea, the household proportion of food expenditure decreased and consumer demand for more diversified agriculture products expanded. Due to the need for diversified products, a shift toward importing some of the agriculture products took place. This increase is also a result of population growth, limited agricultural resources, an increase in wealth, and lower prices *(*Gillman, 2007). The shift toward more agricultural imports has made Korea a net importer of agricultural products since the 1960s (Figure 4.6). However, the Korean economy dramatically increased net imports of agricultural products in 1992, registering a value of approximately $5 million in 1992 at the end of the transforming Korea period. As the economy continued to grow in an urbanized world, Korea continued to register a need to import more agricultural commodities than it exported. Due to the convenience of imported products, changes in lifestyle and work, and the attractive market price, processed foods, a variety of beverages, and meat became more important in overall food

consumption. This increase in reliance on agricultural imports is another manifestation of the declining comparative advantage of the agricultural sector.

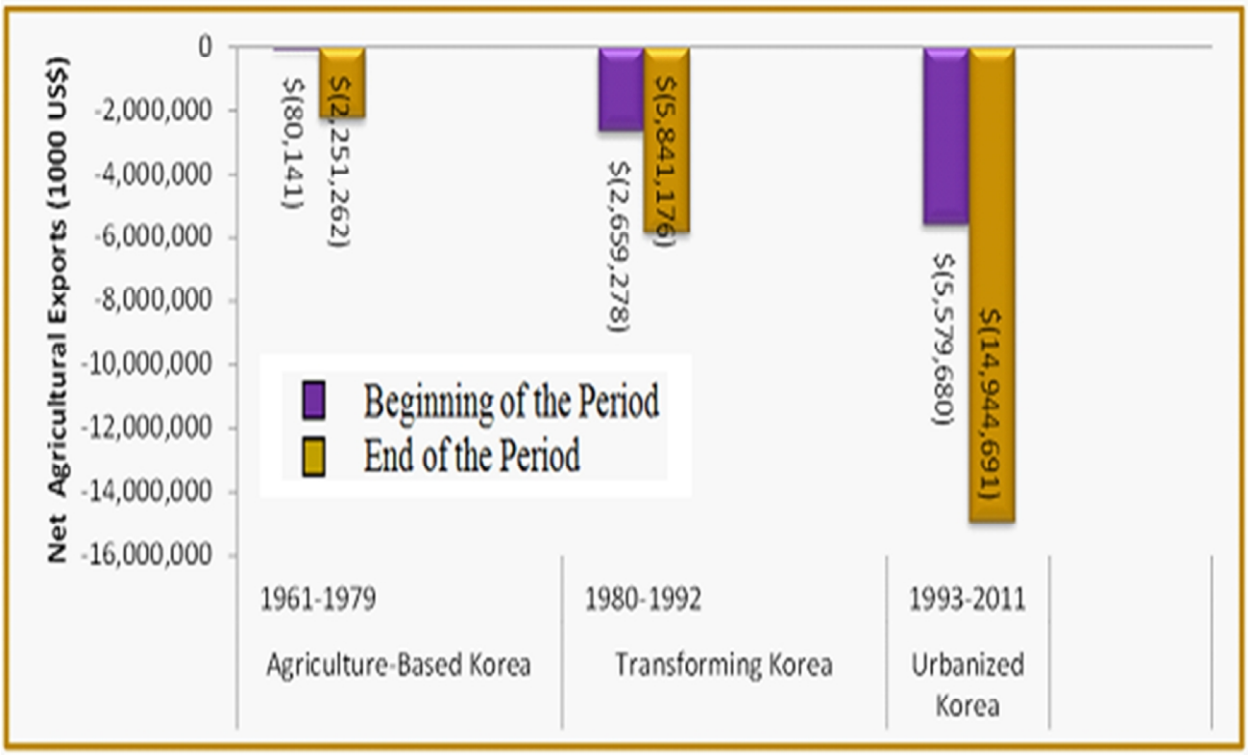


Figure 4.6. Agricultural Net Exports, Korea, 1961-2011.

4.3.1.6. Agricultural Policy and Protection

As the remarkable, rapid industrialization was achieved, it produced pressure to provide support for domestic agriculture. To ensure low food prices were available to the urban sector, the Korean government deemed it necessary to provide incentive to the rural populace to stay on the farm. The intervention was later redirected towards encouraging the expansion of domestic food output, which was seen as a necessary measure for the continuation of industrial growth and the Korean national security (Francks *et al*., 2006). These agricultural protection policies support agriculture in the interests of industrialization (Moore, 1985). The state interventions also started while the rapid industrialization growth was still unstable (Francks *et al*., 2006).

All kinds of assistance (tariffs, quotas, price support, subsidized credit, state-funded infrastructure investment) were offered to producers of a wide range of agricultural goods. Central to these government interventions, rice, the symbolic 'staple food' of the region, was provided exceptionally high levels of support and border protection, which was deemed necessary to achieve the goal of complete national self-sufficiency. These protections rose to levels that are necessary to maintain the position of farm households in the face of the dramatic growth of industrial labor productivity and incomes. Figures 4.7 and 4.8 present the trend of some Korean agricultural protection in comparison to other countries such as Japan, Taiwan and European Communities (EC). As shown, the interventions are reflected in the dramatic increase in the nominal rate of agricultural protection (domestic prices as a percentage of border prices) from around the second half of the 1970s, at a time when Korea's trade in manufactured products was being increasingly liberalized. By 1990, border protection for agricultural producers exceeded the average for the EC, by a long way.

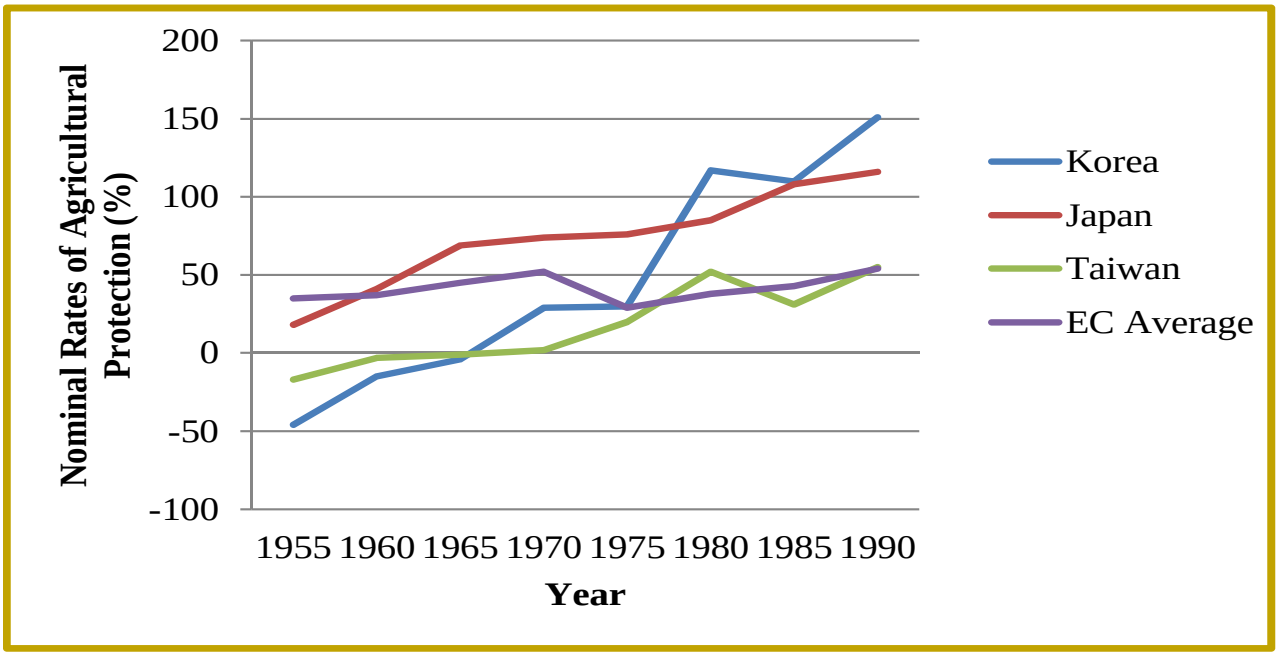


Figure 4.7. Nominal rates of Agricultural Protection (%), Selected Countries, 1955-1990.
Source: Homma, 1994.

Similarly, there were high levels, relative to the EC and Taiwan, and steady growth through the 1980s of overall direct and indirect transfers to the Korean agriculture producers (Figure 4.8). The transfers to agricultural producers increased significantly in South Korea, resulting "in the highest Producer Subsidy Equivalents (PSEs) of any Pacific Rim nation" (USDA, 1992) by the end of the 1980s. Protection of Taiwan's agriculture was much lower than South Korea's, though Japan was still higher than Korea until the late 1980s.

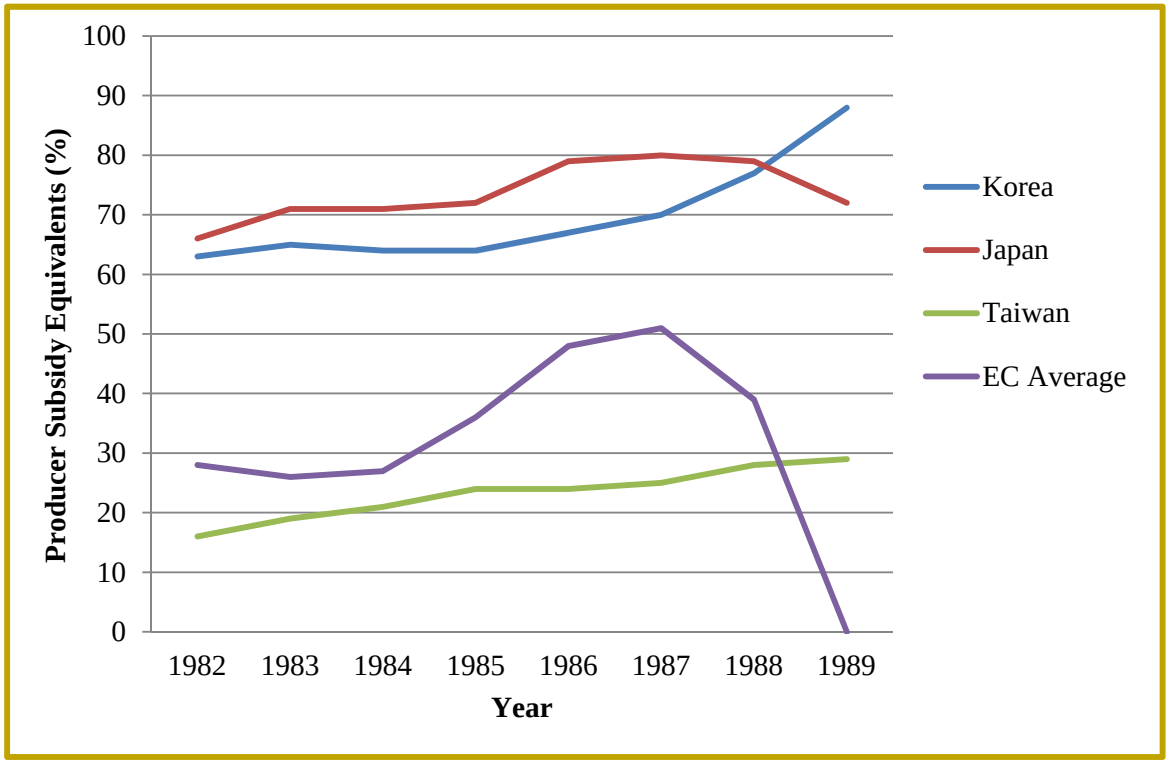


Figure 4.8. Producer Subsidy Equivalents, Selected Countries, (%), 1982-1989.
Source: Huang, 1993.

4.3.1.7. Openness to Trade and Exports

The dramatic increase in the nominal rate of agricultural protection noted in the previous section occurred from about the second half of the 1970s at a time when Korea's trade in manufactured products was being increasingly liberalized (Francks *et al.*, 2006). The Park regime, which came into power in 1961 and committed itself to economic development, pursued active, comprehensive policies of trade reforms and export promotion. Exporters were provided

with extensive direct export subsidies and other incentives, including tax exemption, and export loans with preferential interest rates. The government also undertook a series of policies to promote the inflow of foreign capital to make up for the deficiency of domestic savings (Lee, 2003).

Korea's industrialization strategy depended heavily on access to the world market for its exports. At the same time, despite the 'free trade' environment created for exporters and continued dependence on a high level of imports of raw materials, significant import restrictions continued to exist and were intensified during the Heavy and Chemical Industrialization drive of the 1970s, but continued to be able to claim favorable treatment as a developing country with balance-of-payments difficulties. This enabled it to gain the most-favored nation status in regards to accessing developed-country markets for its exports, whilst still maintaining its own quantitative and other import restrictions (Young, 1989). However, attacks on Korean protectionism began to be mounted, especially by the United States, from the late 1970s onwards and the Korean government itself, reacting to the problems of over-investment and inefficiency generated by protection during the heavy industrialization drive, also launched programs of import liberalization on its own initiative during the 1980s.

Thus, by the time the Uruguay Round negotiations got underway in the second half of the 1980s, relatively few products remained subject to import restrictions. However, protection continued to rise on agricultural products including soybeans, rice, beef, and corn, through quantitative restrictions and tariffs, while the protection of the manufacturing sector was being reduced. According to Young (1989), of the 547 (out of 10,241) product categories still under restrictions in 1989, only 46 were industrial products.

Export growth in Korea improved markedly during the 1961-1979 period. The agriculture-based Korea, was therefore, a period of phenomenally rapid, export-led industrial growth (averaging around 26.27% per year), which caused a substantial shift of resources (labor and capital) out of agriculture (Table 4.1). This export growth was concentrated on products in which Korean producers had competitive advantages (labor-intensive manufacturing industries) that increased manufacturing output up to 40 percent by 1970 (Sakong, 1993) which later shifted towards heavy industries. As Korea transitioned from an agrarian to an urbanized economy, exports grew by 16.59% each year from about $220 million in 1960 to $548 billion in 2012 when measured in 2005 US constant prices.

Table 4.1. Export Growth, Period Averages.

Country Type	Average Annual Export Growth (%)
Agriculture-Based (1961-1979)	26.27
Transforming (1980-1992)	11.00
Urbanized (1993-2012)	12.05
Average (3 Periods)	16.44

The annual growth rate of exports of goods and services is based on constant local currency.
Source: WDI, accessed January 3, 2014.

South Korea's economic freedom score is 70.3, making its economy the 34th freest in the 2013 Index, which is regarded as a "mostly free" economy by the Heritage Foundation. The trade-weighted average tariff rate is 8.7 percent but likely will decline in the future as new free trade agreements are implemented. The economy is increasingly open to foreign investors, and the investment regime has become more transparent. The financial sector has become more competitive, although business start-ups still struggle to obtain financing. The banking sector remains largely stable. Korea's vibrant private sector, bolstered by a well-educated labor force and high capacity for innovation, has capitalized on the country's openness to global trade and

investment. South Korea has proactively entered into free trade pacts with leading economies, including the United States and the European Union in 2013.

To put the numbers on the trade freedom index in perspective, it is worth comparing the level of trade openness of Korea with urbanized countries such as Japan, the EU and the United States as measured by the same index. During the 1995-2013 periods, Japan was freer than South Korea with an average index of 81 versus 70. The United States was among the countries that had the highest average index, 82, along with Canada, Germany, Spain, Sweden and UK. Russia had the lowest index of 59 among the countries in Europe randomly selected.

4.3.2. Gross Domestic Product (GDP)

The results of the comprehensive changes Korea undertook toward export orientation proved quite effective as demonstrated by an impressive GDP growth rate (Table 4.2). As expected, the rapid declines in agriculture's share to GDP previously noted are coupled with an increasing gross domestic product (GDP) per capita from a low of $1,467 in 1960 to $21,562 in 2012 (in constant 2005 US$). Over the same period, Korea's GDP increased from $37 billion to $1 trillion, experiencing an average growth rate of approximately 7 percent. The Gross National Income (GNI) per capita as measured in constant 2005 US dollars rose from $1,486 in 1960 to $21,674 in 2012, averaging a growth rate of 5.51% annually.

Table 4.2. Yearly Growth in GNI and GDP per Capita, Period Averages.

Country Type	Average GNI per Capita Growth	Average GDP per Capita Growth
Agriculture-Based (1961-1979)	5.90	8.27
Transforming (1980-1992)	6.60	7.79
Urbanized (1993-2012)	4.04	3.99
Average (3 Periods)	5.51	6.68

The annual growth rate is based on constant local currency.
Source: WDI, accessed January 3, 2014.

4.4. Data and Methodology

4.4.1. Economic Model

As previously noted, there has been considerable debate on how Korea has attained its remarkable record of high and persistent economic growth. However, a number of factors, including a well-educated labor force and a well-directed export-oriented development strategy, have been cited as primarily responsible for the Korean success. The economic model in this chapter builds on work of previous researchers by including other macroeconomic variables considered important in explaining the Korean rapid economic growth. The static model below conjectures that Korean economic growth (GDP), is a function of agriculture (agr), exports of goods and services (exp), and a well-educated labor force (Sch).

$$GDP_t = f(\overset{+}{Agr}_t, \overset{+}{Exp}_t, \overset{+}{Sch}_t) \qquad \text{(Eq. 4.1)}$$

The expected relationship between each of the explanatory variables with the dependent variable are indicated by the signs above the variables and discussed in the following paragraphs.

4.4.1.1. Agriculture

Pinkston (2007) reports that Park Chung Hee was cognizant of the linkages between agriculture and industry, and he targeted the rural sector for development as part of his industrialization strategy:

> "More than anything else, Korea's late development has been due to backwardness in agricultural production and insufficient food supplies. Agriculture has not been able to provide the essential raw materials for industrialization, and the paltry incomes of farm households are the cause of extremely depressed markets for industrial goods. Therefore, industrialization is impossible without agricultural development; it is a precondition for the normal development of an industrial base" (Park Chung Hee, as quoted by Pinkston[23], 2007).

[23] Quoted by Pinkston in "Bag-dae-tonglyeong yu-sin <ji-bangjanggwan-hoe>" [President Park's Instructions: A Meeting with Provincial Governors], *Nonghyeob-sinmun* [The Cooperative News], August 31, 1964.

Park Chung Hee's statement is consistent with the theoretical support in the role of agriculture in economic development. As previously noted, the structural transformation from a predominantly agricultural to a predominantly industrial economy occurred in Korea as it had in the West, but within an unprecedented compressed time scale, transforming from a very poor country in the late 1950s to an industrial country by the late 1980s (Francks *et al.,* 2006). The land reforms were a major factor in getting the country's industrialization started and agrarian reform took place before any significant industrialization (Kay, 2002).

4.4.1.2. Exports

Various records in the academic literature cited that international trade has been the core of the remarkable growth of the Korean economy. That is, the Korean economic growth can be attributed to market-oriented policies and the reduced role of government intervention (Rodrik, 1996; Baer *et al.,* 1999). In contrast to the over-controlled, over-regulated, and highly distorted economies in other East Asian countries, the Korean economy has been characterized by diminishing intervention in most spheres of economic activity, and a much smaller degree of distortion (Krueger, 1993). Korea demonstrates just how faithful, consciously or not, the Korean government had been to the American concept of free enterprise (Wade, 1990).

4.4.1.3. Well-educated Labor Force

Benhabib *et al.,* (1994) assumes that a well-educated labor force is better at creating, implementing, and adopting new technologies, thereby generating growth. South Korea has the highest average education stock and the highest growth rate of education stock among developing countries (Nehru *et al.,*1995). It is the impressive investment in human capital (education, in particular) that has boosted South Korea's economic growth far beyond the level of other South and East Asian economies (Harvie and Pahlavani, 2006). These authors conclude

that in the long run, policies aimed at promoting various types of physical and human capital, and trade openness improved Korea's economic growth in 1980-2005, allowing it to rely upon a highly skilled labor force.

The Korean economy built up rapidly after 1962-63 by emphasizing labor-intensive processing of imported raw materials and intermediate goods. This is the area in which Korea had a comparative advantage: a skilled labor force combined with a low wage structure (Benjamen, 1982). Furthermore, Edwards (1992) and Levin and Renelt (1992) point out that market reforms are associated with growth only in those economies that have appropriate human capital to efficiently absorb new developments.

There is a significant contribution of human capital to GDP growth (Mankiw *et al.,* 1992). Barro and Salai-Martin (1991) found that the average years of schooling have a significant positive impact on the economic output. Other studies that explored the relationship between the accumulation of human capital and the economic output include Schultz (1961, 1962a, 1962b, 1963, and 2003) and Bils and Klenow (2000). These authors identified a significant contribution of human capital to economic growth.

In 1960, about 56 percent of the adult Korean population had received some primary education, whereas 20 percent had even obtained some secondary schooling. In contrast, in 1945 about 87 percent of adults had never received any formal schooling. By the early 1960s, because of its early investment in education, Korea already had a substantial stock of human resources. Korean’s educational attainment far exceeded those of other developing countries, in which only 26 percent of adults had primary school education and only 5 percent had some secondary schooling (Lee, 2003).

4.4.2. Data and Econometric Method

4.4.2.1. Data

In this study, economic growth is analyzed using annualized data over the period 1961-2012. The dummy variable classification used, agriculture-based, transforming, and urbanized Korea, were determined based on the World Bank's criteria on classifying a country into the three worlds of agriculture as outlined in its 2008 development report. The variables on GDP per capita, agriculture value-added and exports of goods and services were obtained from the World Bank 2012. The measurements of these variables are further explained in Appendix 7.

The schooling variable is based on Barro and Lee's 2013 measure of average schooling for the population age 25 and older. These authors surveyed information compiled by UNESCO as benchmark figures to estimate average years of schooling at 5-year intervals from 1950 to 2010. These census figures report the distribution of educational attainment in the population over age 15 by sex and by 5-year age groups, at 5-year intervals. The Barro and Lee archive is actually composed of two datasets. The first contains attainment data for the population 15 and older (15+); the second contains attainment data for the population 25 and older (25+). Each dataset gauges a country's educational attainment by listing the proportion of the population in each of four categories: no formal education, primary, secondary, and tertiary. It is further classified in many cases into subcategories: incomplete primary, incomplete secondary and incomplete tertiary. The data on the distribution of educational attainment among the population, combined with the information for each country on the duration of school at each level, generate the number of years of schooling achieved by the average person at various levels and at all levels of schooling combined. Please refer to Appendix 8 for the formula used by Barro and Lee (2013) in calculating average years of schooling. A review of the pertinent literature suggested that the work of Barro and Lee in refining and extending the original UNESCO data has been the most sophisticated and

ambitious such that their papers have been cited by various journals and articles (Barro and Lee, 2013).

Because the original Barro and Lee data were in five year intervals from 1955 through 2010, this study expanded it to a country-year format by assuming that the average years of schooling within the 5-year interval is the same. For instance, the average years of schooling in Korea in 1960 was reported to be 3.23; hence, the schooling variable from 1961-1964 is set to 3.23 as well.

4.4.2.2. Methodology

As the structural transformation from a predominantly agricultural to a predominantly industrial economy occurred in Korea, this study examines the relationship between Korean agriculture and economic growth by specifying a vector autoregressive model with exogenous variables called the VARX model. The process can also be affected by the lags of the variables, a VARX(*p,s*) model. An example of VARX(1,0) model can be written as:

$$GDP_t = b_0 + b_1 GDP_{t-1} + r_1 Agr_t + r_2 Exp_t + r_3 Sch_t + r_4 D_{Agrt} + r_5 D_{TEt} + r_6 D*Agr_t + r_7 D*TE_t + m_t, \quad Eq.4.2$$

where:

GDP = Gross Domestic Product per capita in constant 2005 US prices
Agr = Agriculture Value-Added in constant 2005 US prices
Exp = Exports of goods and services in constant 2005 US prices
Sch = Average years of schooling, Barro & Lee's 2010 measure
t = time measured in year
*D*Agr* = interaction of Agr and dummy variable D_{agr}
*D*TE* = interaction of Agr and dummy variable D_{TE}

$$D_{Agr} = \begin{cases} 1 & \text{if Korea is classified as an agricultural-based in year t} \\ 0 & \text{Otherwise} \end{cases}$$

$$D_{TE} = \begin{cases} 1 & \text{if Korea is classified as a transforming economy in year t} \\ 0 & \text{Otherwise} \end{cases}$$

According to Bauer *et al.*, (2006) the data generating process can be approximated reasonably well using a VARX(*p,s*) specification and that a large area of research in time series

started with the seminal papers of Berk (1974) and Lewis and Reinsel (1985) dealing with finite order autoregressive approximations to processes of this kind. This model has been justified by many researchers to be an appropriate framework for describing economic growth (Bauer *et al*., 2006).

As noted in the previous section, other researchers have considered other variables as mechanisms of how Korea achieved an outstanding record of high and continued economic progress. This study, therefore, assessed agriculture's contribution after controlling for other variables that may affect economic growth as shown in *Eq 4.2*. The modeling process consists of the following stages:

1. Testing for stationarity;
2. Testing for cointegration;
3. Model specification and estimation; and
4. Model diagnostic checking.

Each of the above stages is fully described in the next sections as the modeling process is conducted and results reported.

4.5. Results and Discussion

4.5.1. Descriptive Analysis

Table 4.3 shows the descriptive statistics of macroeconomic variables analyzed in this chapter while Figure 4.9 graphs these macroeconomic variables over time. The time series plots show that the macroeconomic variables have upward trends over the period 1961-2012.

Table 4.3. Summary of Descriptive Statistics, 1961-2012.

Descriptive Statistics	GDP per capita (constant 2005 US$)	Agriculture value-added (constant 2005 US$)	Exports of goods and services (constant 2005 US$)	Ave. Years of Schooling (Barro & Lee, 2013)
Average	8,441	19,673,740,886	108,524,525,180	7.88
Max	21,226	29,058,201,081	548,485,333,750	11.69
Min	1,467	9,092,059,331	219,771,572	3.23

The annual average real GDP per capita for Korea from 1961-2012 is US $8,441. It followed a generally upward trend (Figure 4.9a), reaching its highest in 2012 (US $21,226) and lowest in 1961(US $1,467). Annual agriculture value added with 2005=100, from 1961-2012 had an average of US $19.67 billion with a maximum value of US $29.05 billion recorded in 2009. This variable also followed an increasing trend during the period of analysis. The real export of goods and services also followed an upward trend since the 1980's with an average of US $108.5 billion. The highest export of goods and services was recorded in 2012 when the country exported a total of US $548.48 billion in real terms. The lowest observation for export was in 1961, when in real terms, the country exported only US $219.77 million. In 2010, the Korean population over age 25 was estimated to have 11.69 years of schooling, compared to 3.23 years in 1960, as measured by Barro and Lee (2013).

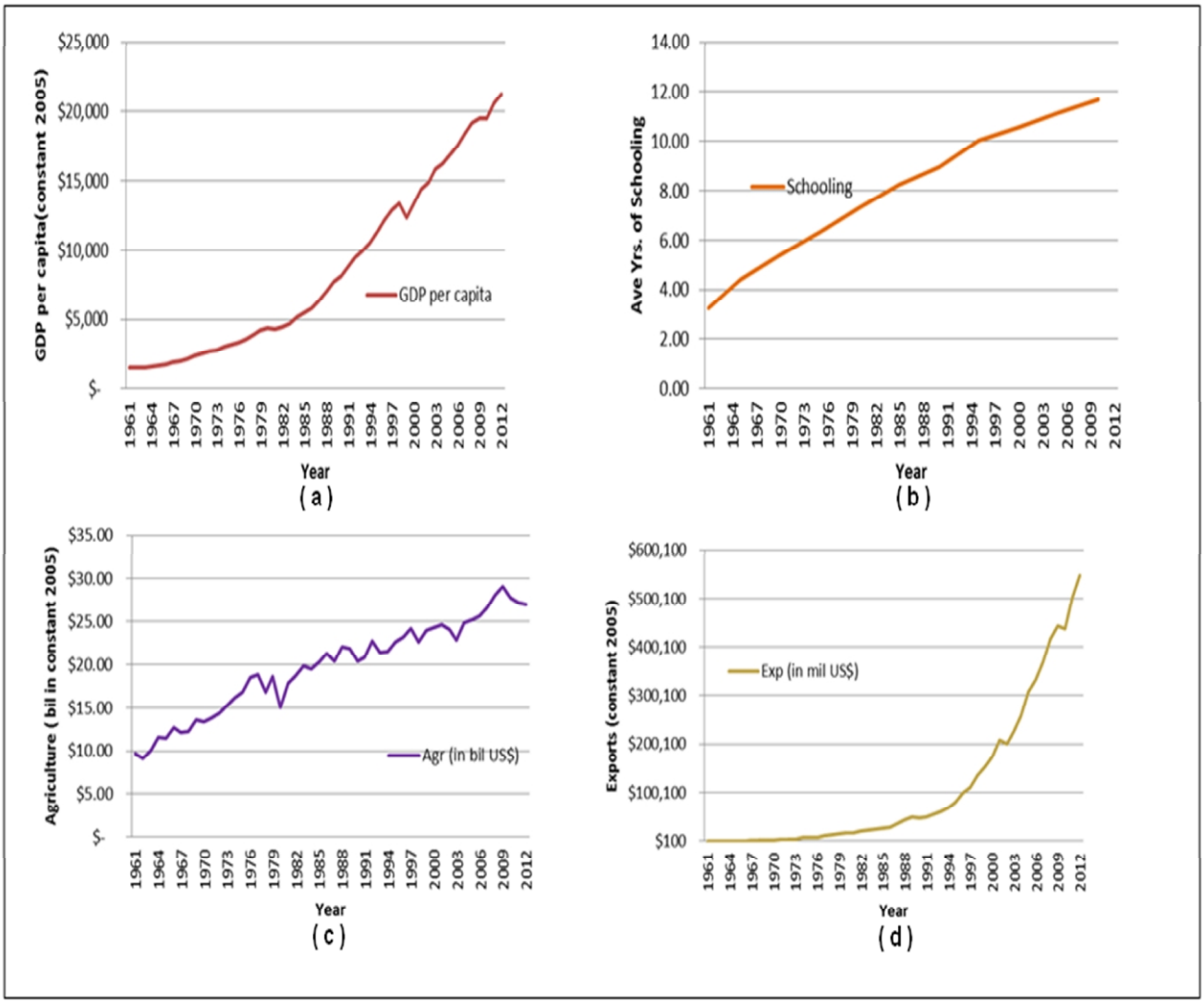


Figure 4.9. Macroeconomic Variables Overtime, 1961-2012.

4.5.2. Stationarity Test

This chapter employs a VARX model, which respectively takes into account and captures the unit root behavior and the dynamics of the variables. The Dickey-Fuller procedure is used to test the null hypothesis that the series has a unit root in the AR polynomial. The equation for the augmented Dickey-Fuller test is estimated (*Eq. 4.3*), where Y is the time series variable under investigation (GDP, exports, schooling and agriculture).

$$\Delta Y_t = a_0 + gY_{t-1} + a_1 T + \sum_{i=1}^{p} b_i \Delta Y_{t-i-1} + e_t \qquad \textit{Eq. 4.3}$$

The additional lagged terms, *p*, are included to ensure that the errors are uncorrelated which is selected based on the SBC criterion. The test also includes a linear time trend since the time series plots reveal a linear trend. Further, the AR model estimates of each time series show that the year or trend variable is significant. The results of stationarity tests using the SAS Proc ARIMA procedure are summarized in Table 4.4. The ADF tests were conducted using the variables that are transformed into logs of the original values.

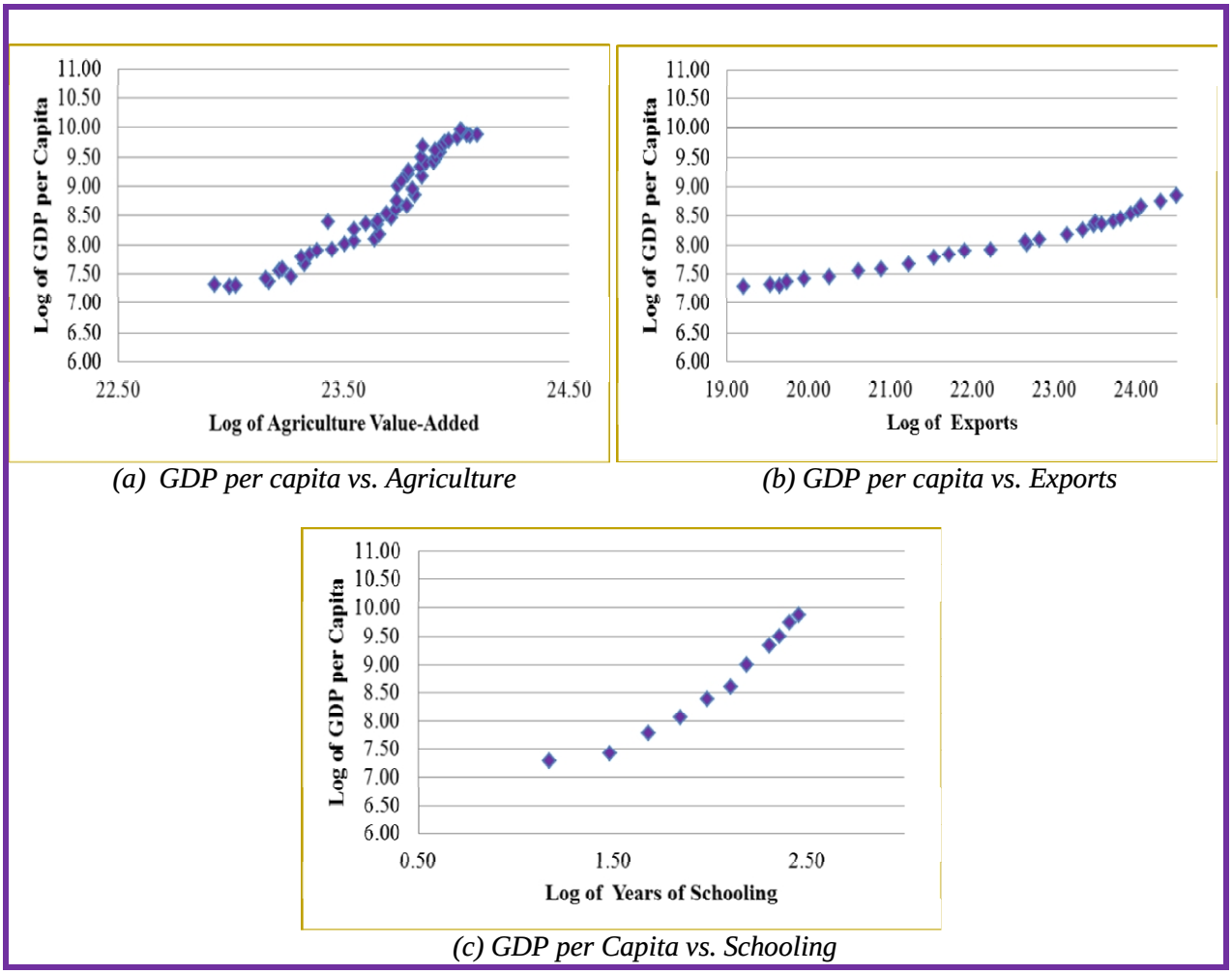
Table 4.4. Result of Unit Root Tests, Macroeconomic Variables, 1961-2012.

Variable (in log form)	**ADF Test, SBC Criterion (*tau* p-values) (Ho: Series has a unit root.)**	
	Level	First Difference
GDP	0.9883	0.0207
Agriculture	0.1369	0.0016
Exports	0.5058	0.0296
Ave. years of schooling	0.2536	<.0001

The ADF tests indicate that the macroeconomic series included in the model may have a difference-stationary process as shown by significant p-values of the statistic *tau*. That is, the results clearly show that all the variables have a unit root at the level, but become stationary after first differencing. These results satisfy the preliminary condition for further cointegration tests, which are necessary for the VARX model estimations.

Since the stationarity test revealed that the time series could be regarded as $I(1)$, the next step is to conduct cointegration tests among the variables in the model. Based on the VAR framework, if a linear combination of the non-stationary variables is stationary, the variables are cointegrated. The linear combination of the variables presents a stochastic co-movement between the variables (Lütkepohl, 2005). The cointegration test is a preliminary condition for the empirical framework of the VARX model (Bauer *et al.,* 2006). This test was carried out using the SAS Procedure on Proc VARMAX, based on the Phillips-Ouliaris test of cointegration. Since

all four variables in the model are presumed to be jointly determined, the long-run equilibrium regression can be estimated using GDP, agriculture, exports, or years of schooling as the "left-hand-side" variable or regressand. The essence of the test is to determine whether the residuals from estimating the long-run equilibrium relationship are stationary. In performing the test, there is no presumption that any one of the residuals is preferable to any of the others. Figure 4.10 presents a graph of the natural log of GDP per capita vs. other macroeconomic variables.



(a) GDP per capita vs. Agriculture

(b) GDP per capita vs. Exports

(c) GDP per Capita vs. Schooling

Figure 4.10. GDP per Capita vs. Other Macroeconomic Variables, 1961-2012.

The results of the cointegration test on the natural log of the variables are summarized in Table 4.5. Upon validation of the significance of a constant and a trend in the model, the years of schooling, when used as a regressor, included a constant but no trend term in the model. For

the rest of the variables (GDP, Agr, Exp), both terms are included as they appear significant. The hypothesis of no cointegration is to be rejected if *rho* or *tau* is below the critical values of desired type 1 error alpha.

Using the variable GDP per capita as the regressand, it can be concluded that at 5% level of significance, the variables are cointegrated of order (1,1). Therefore, the Korean economic growth and its macroeconomic determinants exhibit a long-run relationship. That is, real GDP per capita, exports of goods and services, agriculture valued added and years of schooling tend to move together over the entire period of analysis (1961-2012). In all level of significance, the rest of the regressions show that variables are also cointegrated of order (1,1) as supported by the *rho* statistics all smaller than the *rho* critical values.

Table 4.5. Results of Phillips-Ouliaris Cointegration Test, 1961-2012.

Regressand	**Test Statistics**		**Critical Values**					
	Rho	*Tau*	*1%*		5%		*10%*	
			Rho	*Tau*	*Rho*	*Tau*	*Rho*	*Tau*
GDP	-26.02	-4.03	78.34	-4.65	60.24	-4.16	52.00	-3.84
Agriculture	-33.85	-4.67	78.34	-4.65	60.24	-4.16	52.00	-3.84
Exports	-31.60	-4.51	78.34	-4.65	60.24	-4.16	52.00	-3.84
Years of schooling	-46.29	-6.47	63.41	-4.73	46.73	-4.11	39.69	-3.83

SAS does not provide the p-values but only the values of test statistics denoted by rho and tau. The critical values of Phillips-Ouliaris Cointegration Test for the case of 3 variables using 500 observations were calculated by Peter C. B. Phillips and S. Ouliaris, Asymptotic Properties of Residual Based Tests for Cointegration," Econometrica, Vol. 58, 1990, 165-93

4.5.3. The VARX Model Estimation Results

As reported in the previous section, the time series variables are non-stationary. However, the linear combination is stationary as shown in the result of the cointegration test.

Hence, the VARX model presented here is estimated in log levels rather than first differences. Differencing data that are non-stationary but cointegrated is counterproductive (Greene, 2012).

We consider tests of the null hypothesis that agriculture does not Granger cause GDP per capita *after* controlling for other variables. As shown in Figure 4.10, there is obvious co-movement among the variables, which is confirmed by a significant cointegration test in the previous section. The long-run relation could also be affected by the lags of the exogenous variables. Hence, models that also include lags of the exogenous variables were tested in the empirical specification to consider linear alternatives to Granger noncausality tests. This was carried out by estimating various VARX (*p,s*). The appropriate number of *p,s* is chosen based on a model with the lowest SBC. The final model is a VARX (1,0). That is, 1 lagged dependent variable and 0 lagged independent variable is included in the model. The fitted VARX(1,0) in log levels is given in Table 4.6.

Table 4.6. Parameter Estimates, Log Levels of the Variables, 1960-2012.

Dependent Variable: Log Levels of GDP Per Capita				
Variable	**Estimate**	**Standard Error**	**t-value**	**Pr > |t|**
Constant	3.9046	2.8076	1.39	0.1716
$Agr_{(t)}$	-0.1676	0.12939	-1.3	0.2023
$Exp_{(t)}$	0.05272	0.02726	1.93	0.0599
$Sch_{(t)}$	0.08793	0.08653	1.02	0.3154
$D_{Agr(t)}$	-0.8221	2.54541	-0.32	0.7483
$D_{TE(t)}$	-9.004	3.16944	-2.84	0.0069
$D*Agr_{(t)}$	0.03304	0.10757	0.31	0.7602
$D*TE_{(t)}$	0.37846	0.13306	2.84	0.0069
GDP(t-1)	0.85026	0.06875	12.37	0.0001

The VARX estimates show that exports of goods and services is a significant exogenous variable in the model. Previous year's GDP per capita, $GDP_{(t-1)}$ in Table 4.6, is also important in

explaining GDP per capita in the current year. The model also indicates that agriculture and average years of schooling do not explain GDP per capita. The dummy variable that represents Korean agricultural-based economy ($D_{Agr(t)}$) is also not significant, suggesting that the effect of agriculture to GDP per capita in a Korean agriculture-based economy does not significantly differ with the Korean urbanized economy. This result was not as expected per the 2008 World Bank's Development Report. On the other hand, the dummy variable that represents Korean-transforming economy $D_{TE(t)}$, has a significant effect on GDP per capita. This result suggests that agriculture's contribution to GDP per capita differs in a transforming Korean economy from the urbanized Korea. As shown, its effect is lesser than the urbanized economy by 9.004%. Such a result is consistent with the expectation of the 2008 World Bank Development Report.

The VARX model considers the effect of agriculture to GDP per capita in a given type of economy (agriculture-based, transforming or urbanized). This is measured by introducing interaction terms ($D*Agr_{(t)}$ and $D*TE_{(t)}$) shown in Table 4.6. The VARX estimates show that the effect of the agriculture to GDP per capita in a Korean-based economy is not dependent (p-value=0.7602) on its share to GDP (i.e., an agriculture-based economy has a higher share of agriculture to GDP and keep decreasing as the economy transitioned toward urbanized one). The result also suggests that this effect is not significantly different from a Korean urbanized economy. However, in a Korean transforming economy, agriculture's contribution to GDP per capita is significant. These results also suggest that the effect of agriculture on GDP in a transforming Korea differs with the urbanized Korean economy (p-value=0.0069). In this case, the effect of agriculture on GDP is significantly more dependent in a transforming economy than in an urbanized one, as supported by a positive coefficient of 0.37846.

4.5.4. Univariate Model Diagnostic Checks

A series of diagnostic tests were carried out for the VARX model presented in the previous section. The test results reveal that the estimated VARX (1,0) model fits very well with the observations. It shows that the model is significant with an R^2 of .9989 (Table 4.7). The tests for white noise residuals are reported in Table 4.8. The residuals are uncorrelated up to lag 12 as supported by p-values all greater than .05. For the purpose of illustration, only the results up to lag 5 are reported here.

Table 4.7. Univariate Model ANOVA Diagnostics.

Variable	R-Square	Standard Deviation	F Value	Pr > F
LGDP	0.9989	0.03062	4802.78	<.0001

Table 4.8. Portmanteau Test for Cross Correlations of Residuals

Up To Lag	DF	Chi-Square	Pr > ChiSq
2	1	2.52	0.1122
3	2	2.54	0.2814
4	3	3.65	0.3023
5	4	5.48	0.2414

The SAS PROC VARMAX also provides additional model diagnostic tests. The results are presented in Table 4.9. This output contains information that indicates whether the residuals are heteroskedastic and correlated. The Durbin-Watson statistics is used to test the null hypothesis that residuals are uncorrelated. The Jarque-Bera normality test is helpful in determining whether the model residuals represent a white noise process. The F-tests for autoregressive conditional heteroskedastic (ARCH) disturbances test for the heteroskedastic disturbances in the residuals. The results of the diagnostic tests presented in Table 4.9 shows

that the residuals are off from the normality but have no ARCH effects. There is no evidence of serial autocorrelation as supported by the DW test statistic value close to 2.

Table 4.9. Univariate Model White Noise Diagnostics.

Variable	Durbin Watson (DW) Ho: Residuals are uncorrelated	Normality Ho: Residuals are normal		ARCH Ho: Residuals have equal variances.	
		Chi-Square	Pr > ChiSq	F Value	Pr > F
GDP	2.24606	57.26	<.0001	0.00	0.9516

4.5.5. Granger-Causality

The direction of the causality between agriculture and GDP per capita can be investigated using the Granger causality test. The test was implemented using SAS Proc VARMAX and summarized in Table 4.10.

Table 4.10. Result of Granger Causality Test, Korea, 1961-2012.

Null Hypothesis	Chi-Square	Pr > ChiSq	Conclusion
Agriculture growth does not cause economic growth	0.5517	<.0001	Growth in agriculture causes GDP per capita growth
GDP per capita growth does not cause agricultural growth	5.6800	0.0171	GDP per capita growth causes agricultural growth
Overall Conclusion: There is a bidirectional causality between agricultural and GDP per capita growth.			

The results of the tests demonstrate that by applying a VARX model on the annual data from 1961-2012, a feedback relationship exists (i.e., GDP per capita growth causes agricultural growth and vice versa). This analysis suggests that the Korean economy followed the path of agriculture-first industrialization. At the same time, the result also suggests that agriculture is playing a reactive role. That is, the growth in agriculture is a result of overall economic growth.

4.6. Conclusion

Using the Granger causality test, there is empirical evidence to support the argument that there is a bidirectional relationship between agriculture and economic growth in Korea, based on data from 1961 to 2012. The World Bank (2008) argues that in agriculture-based countries, agriculture can be the main engine of economic growth and is less important in transforming economies. Agriculture plays the same role as other tradable sectors and subsectors with a comparative advantage in stimulating economic growth in urbanized countries of the world. The results of empirically testing this argument using observable data show that the effect of agriculture to economic growth is only significantly different between transforming and urbanized economies. Further, the effect of the transforming economy is significantly greater than the urbanized effect (higher by 9.004%). When tested as to whether the effect of agriculture is dependent on the country's stage of development (i.e. agriculture-based), the agriculture sector contributes to economic growth in a Korean transforming economy but not in the agriculture-based or urbanized economy. The result that agriculture in urbanized Korea does not impact the economy may be intuitive since Korean agriculture is reported to have no comparative advantage. On the other hand, the result of non-significance of agriculture in the agrarian Korea may support the argument in literature that Korea achieved industrialization without an agricultural revolution but is inconsistent with the 2008 World Development Report where agriculture is expected to be more important in an agrarian economy. When tested as to whether the effect of agriculture is dependent on the country's stage of development (i.e., agriculture-based), results showed that in agriculture-based and urbanized Korea, there is no evidence that agriculture contributes to economic development. Interestingly, while Korea was a transforming economy, agriculture significantly contributed to economic growth.

The result that only during the transforming Korea agriculture contributes to overall economic growth deserves some further explanation. As previously noted, agriculture did not lead to economic growth during the Korean agriculture-based stage of development, but contributed during the transforming Korea, which is not consistent with the World Bank's expectation. During the agriculture-based Korea, infrastructure and communications were less well developed, partly because the Japanese had invested less, especially in the south of the peninsula, and partly because industrial and trading activity there was concentrated around Seoul and Pusan, away from the main agricultural areas (Moore, 1985). However, it can be argued that the government believed that what happened in agriculture during the agriculture-based Korea would continue to affect the extent to which agriculture could contribute to the economy during the next stages of economic development (i.e., transforming Korea). The Korean government, therefore, did not ignore agriculture during the agriculture-based period and continued to establish mechanisms for state intervention in agricultural production and agricultural markets, despite the possibility that the agriculture sector would not significantly contribute to economic growth at this period. That is, the government policy during the agriculture-based stage of development favored the agriculture sector that may have played a role in facilitating agriculture's positive contribution to economic growth during the transforming stage of development. As discussed in this chapter, the higher levels of protection for Korean agriculture began in the 1960s and Korea shifted from taxing agriculture to subsidizing it in the early 1970s. Further, government expenditure on agriculture, forestry and fisheries more than tripled in real terms between 1963 and 1975, growing faster than GNP, and government investment and loans to these sectors represented about one-quarter of the government's total investment and loans throughout (Mason *et al,* 1980.). It can be assumed that the effects of these investments were

strongly felt only in the agriculture sector as it transitioned to a transforming economy between 1980-1992, thus contributing more in economic development than during the time of these investments (i.e., agriculture-based) because of lagged effects of investments.

As Korea entered the transforming stage of development, (1980), the manufacturing and export sectors had already been established. This could have provided the environment for agricultural change that had been conditioned to succeed during the agriculture-based period to play a part in the urbanization process. As confirmed by the effects of the causality test in this chapter, there is a feedback relationship between Korean agriculture and economic growth. Thus, in the case of Korea, the improvement of the overall economy causes improvement in the agricultural sector; hence, agriculture's contribution to the economy is significant during the transforming Korea. The agricultural sector reacted to the increase in the demand for food in the swelling urban centers by producing more. For example, growth in rice output proved inadequate to meet the expansion in domestic demand, and imports were consistently necessary throughout the late 1960s and the 1970s; however, self-sufficiency was already accomplished in the mid-1980s (Francks *et al.*, 2006). Further, by the 1970s, the overvaluation of the exchange rate was being reduced and at the same time domestic price support was coming into operation, so that the overall effect of price and exchange rate policies on intersectoral resource flows shifted from a situation in which there was some transfer from agriculture to industry in the 1960s to one of a reverse flow thereafter (Francks, *et al.*, 2006).

To meet the requirement for industrial labor, migration from rural-urban areas witnessed a rapid increase by the 1960s. This resulted in increases in disposable income. As a consequence, redistribution of income from industry to agriculture occurred as family members who migrated to the urban areas sent remittances to the rural households. This could have resulted in a new

drive to improve living conditions in rural areas, causing substantial investment in roads, electricity provision, housing, etc. in the early 1970s, making the Korean farm households significantly better off in broader welfare terms, as well as in terms of their disposable incomes. It can further be assumed that these remittances provided rural households the ability to save and invest in better agricultural technology. According to the estimates of Ban *et al.*, (1982), farm households began to find themselves in a position to make savings in the early 1960s and their savings rate rose steadily from around 6 percent then to at times over 20 per cent in the early 1970s. These savings occurred during the agriculture-based period. However, it could be assumed that such savings were ultimately invested to agricultural production in the transforming stage of development (1980-1992) making agriculture significantly impactful to the overall economy in this period. According to Francks *et al.*, (2006), the mechanisms whereby such savings could have been transferred to the non-agricultural sector were not well developed, especially in the earlier part of the period. It is therefore probable that most savings were put within the rural sector and even if the whole amount have been transferred, it would have represented no more than 10–20 percent of total gross fixed capital formation.

Finally, the combination of increasing demand for agricultural products, income redistribution from industry to agriculture and the government intervention through infrastructure, protection and marketing, might have caused farmers to shift to agribusiness or commercial production as opposed to personal consumption. Low agricultural prices and the general neglect of agriculture during the 1950s meant that, although total output was growing (at 2.75 percent per annum, during 1954–60; Ban *et al.*, 1982), little had been done to develop the potential of the agricultural economy in terms of commercial crop production or by-employment. With a better infrastructure, farmers, given the remittances, were able to produce more than they

could consume through investment in better technology. Further, with the increasing demand for diversified food in the urban areas, farmers may have specialized their production to some products, further increasing efficiency.

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CHAPTER 5: SUMMARY AND CONCLUSION

The historical experience of most Western developed countries is characterized by an industrialization preceded by an agricultural revolution. However, the agro-pessimists argue that the development policy has suffered from an overemphasis on agriculture, driven by an underlying confusion about the causal relationship between agriculture and development (Gollin, 2010). Indeed, agriculture is the largest employer in poorer countries but this sector might have low growth potential. There is also some evidence of industrialization without any preceding agricultural revolution (Amsden, 1989). Since Asia is inhabited by most of the world's underprivileged population where agriculture is large in terms of both aggregate income and the total labor force, this dissertation examines the empirical relationship between agriculture and economic growth within the experience of the three worlds of agriculture in Asia.

Chapter 2 of the dissertation, entitled "Agricultural-based and Transforming Asia: Is Agriculture the Engine of Growth", presented tests of causality between agriculture and economic growth in bivariate systems using the Toda-Yamamoto and Dolado-Lütkepohl methodology in the agriculture-based and transforming Asian countries. The empirical results suggest that the agriculture-based countries of Bhutan, Lao, Cambodia and Pakistan, show evidence to support the agro-fundamentalists who viewed agriculture as the engine of growth. Hence, the governments of these countries need to formulate policies that would enhance agricultural development to promote economic growth. The TYDL results for Mongolia indicate that economic growth drives agriculture growth. Hence, the agriculture sector can enjoy prosperity with a healthier overall economy. From a policy perspective for countries whose empirical results suggest no causality running in either direction (such as for Nepal, Vietnam and

Bangladesh), the government development policy should emphasize enhancing the other sectors of the economy that have a positive impact to economic growth.

The empirical results in the transforming economies of Asia suggest that for most of this group of countries (Sri Lanka, Indonesia, Philippines and Thailand), there is no causal relationship between agriculture and economic growth. Hence, a development policy geared toward improving other sectors could enhance overall economic growth. In countries such as India, Malaysia and China where agriculture contributes to economic growth, emphasizing agriculture growth could improve the economy. For the Malaysian economy, agriculture and overall economic growth drive each other, suggesting that this country can enjoy economic prosperity by investing in agriculture. At the same time, as the economy prospers, this sector would continue to grow, contributing more to the economy. For the agro-fundamentalists, there is no greater engine for driving growth and thereby reducing poverty and hunger than investing in agriculture, especially in agriculture-based and transforming economies. However, based on the empirical investigation on this chapter, this idea is not supported even in the countries whose livelihood heavily depends on agriculture, such as Nepal and Bangladesh.

In view of the conflicting empirical results in Chapter 2, the next Chapter entitled "Does Globalization Make a Difference" examines the argument in literature that in an open economy, the linkages between agriculture and industry are *less* important than in a more closed economy. Using Ordinary Least Squares, the impact of openness of an economy is taken into account through the interaction of variables that measure, or represent, free trade with the agricultural value-added per worker. Two measures of openness (mean-shift dummies and a trade freedom index) were used, resulting in two models estimated to determine the influence of openness on agriculture's contribution to economic growth. The results show that this notion is only partially

consistent with the evidence from the agriculture-based and transforming economies. As hypothesized, the openness of some economies under investigation negatively affects the gains in the economic growth from improvement in the agricultural productivity. For other countries, the impact of openness is not strong enough to cause a negative relationship between economic growth and agricultural productivity. Further, the effect does not bring large differences in the gains from agricultural productivity between the open and closed economies in most of the countries under investigation using the trade freedom index, but is more supported when using the WTO accession as a dummy variable.

Chapter 4 investigates the role of agriculture in the South Korean economy as it evolves rapidly from a predominantly agrarian society to the predominantly industrial economy. The World Bank (2008) argues that in agriculture-based countries, agriculture can be the main engine of economic growth. In transforming economies, agriculture is less important, but still instrumental in reducing rural poverty. Once the economy became urbanized, agriculture plays the same role as other tradable sectors and subsectors with a comparative advantage in stimulating economic growth. This chapter therefore attempts to investigate the role that agriculture has played in Korea, as argued in the 2008 World Bank development report, and tests this theory empirically using observable data. Hence, this chapter contributes to the ongoing debate on the role of agriculture in the economic transformation of South Korea. This country is a world leader in electronics, telecommunications, automobile production, and shipbuilding and the world's 15th largest economy. It has enjoyed decades of remarkable economic development. The empirical investigation constructed a dummy variable to classify Korea into the three worlds of agriculture to test the argument of the World Bank that agriculture is more important in an

agriculture-based economy and less important in transforming and could play the same role with other sectors that have a comparative advantage.

Employing a VARX (1,0) model, the results shows that the effect of agriculture to economic growth is only significantly different between a transforming and urbanized economy. Further, the effect of the transforming economy is significantly greater than the urbanized one. The result that agriculture in urbanized Korea does not influence the economy may be intuitive since Korean agriculture is reported to have no comparative advantage. On the other hand, the result of non-significance of agriculture in the agrarian Korea may support the argument in literature that Korea achieved industrialization without an agricultural revolution, but inconsistent with the 2008 World Development Report where agriculture is expected to be more important in an agrarian economy. When tested as to whether the effect of agriculture is dependent on the country's stage of development (i.e. agriculture-based), results showed that in agriculture-based and urbanized Korea, there is no evidence that agriculture contributes to economic development. Interestingly, while South Korea was a transforming economy, agriculture significantly contributed to economic growth. It can be argued that the government policies and investments during the agriculture-based stage of development that favored the agriculture sector may have played a role in facilitating agriculture's positive contribution to economic growth during the transforming stage of development. Further, it was estimated that farm households began to find themselves in a position to make savings in the early 1960s, during the agriculture-based period. It could be assumed that such savings were ultimately invested in agricultural production in the transforming period (1980-1992) making agriculture significantly impactful to the overall economy. According to Francks *et al.*, (2006), it is probable that most savings were put within the rural sector and even if the whole amount have

been transferred, it would have represented no more than 10–20 per cent of total gross fixed capital formation as the mechanisms whereby such savings could have been transferred to the non-agricultural sector were not well prepared. Further, labor migration rapidly increased by the 1960s (Mason *et al.*, 1980), again, during the agriculture-based period. This resulted in increases in income that may have been redistributed from industry to agriculture as family members who migrated to the urban areas sent remittances to the rural households. An increase in demand for diversified products also occurred encouraging farmers to specialize in their production. Further, the combination of increasing demand for agricultural products, income redistribution from industry to agriculture and the government intervention through infrastructure, protection and marketing, might have caused the farmers to change over to agribusiness or commercial production as opposed to personal consumption, presumably during the transforming Korea.

The events that occurred during the agriculture-based stage of development may have provided the conditions for Korean agriculture to significantly contribute during the transforming period. In summary, the past investments (i.e., during agriculture-based) in rural infrastructure, adoption of technologies that improve productivity, market institutions, government policies in agricultural protection as well as redistribution of income from urban to rural areas, make the agriculture of the transforming Korea a significant player in the overall economic development. As Korea urbanized itself, agriculture's contribution to the overall economy is insignificant as other sectors with comparative advantage emerge to compete in the world and domestic markets. On the other hand, agriculture in agriculture-based Korea was not a significant contributor to growth since this was just the beginning of the provisions of conditions and/or tools necessary for agriculture to likely succeed in the economic system.

The empirical investigation on the causal relationship between agriculture and economic growth presented in Chapter 2 produces conflicting results using data from the three worlds of agriculture in Asia. That is, both the agro-fundamentalist (who considers agriculture as the engine of growth) and the agro-pessimists (who argued that economic growth causes agricultural productivity), are supported by some countries under study. This conflicting evidence suggests that the development policies must be tailored to the specific environment of a country. For instance, the countries of Nepal and Bangladesh heavily depend on agriculture, but based on the empirical result, agriculture does not contribute to economic growth; therefore, the development policies should concentrate on other sectors that may contribute to agriculture as opposed to following the agriculture-first policy. However, as presented in Chapter 4, the experience of the Korean economy is similar to Bangladesh and Nepal (i.e., agriculture did not lead to economic growth during the agriculture-based Korea). However, it was also during this period (between 1963 and 1975) that the government expenditure on agriculture, forestry and fisheries more than tripled in real terms, growing faster than GNP, and government investment and loans to these sectors represented about one-fourth of the government's total investment and loans throughout (Mason *et al.*, 1980). That is, Korean agriculture did not contribute significantly during the agriculture-based stage of development, but Korean government provided the agricultural sector the necessary tools or conditions to succeed and be able to contribute to economic development in the later period (i.e., transforming). In fact, "the government's commitment to the rural sector was not based on a factor endowment that bestowed Korea with a comparative advantage in farming and livestock products. Rather, the commitment was the result of political decisions as South Korea rapidly industrialized and became integrated with the world economy" (Pinkston, 2007).

In conclusion, a thorough assessment is needed prior to the development and establishment of a policy that could possibly neglect agriculture for agriculture-based economies under investigation whose agriculture does not significantly impact economic growth. In a similar vein, the transforming countries in this study where agriculture does not contribute to economic growth must learn from Korea: point out and provide the necessary condition for agriculture to likely succeed and contribute to economic development. It could be the case where these countries' policies have yet to provide the necessary tools and conditions for agriculture to succeed; hence, agriculture's contribution to economic growth is yet to be determined. A further lesson could be gleaned from the result of this dissertation: the Asian developing countries under study may be allowed to use similar protectionist policies as Korea in order to possibly attain industrialization and catch up with the developed world. According to Francks *et al.,* (2006), the switch towards the support and protection of agriculture occurred relatively early in Korea's industrialization process (i.e., in the 1960s, during the agriculture-based Korea). They further conclude that this kind of protection supported farmers and their income in the face of agricultural adjustment when Korea emerged as an industrial economy in the 1980s. As presented in Chapter 3, Korea's accession to the WTO may have negatively impacted agriculture's contribution to the economy. Hence, building on the case of Korea, a protectionist policy may be vital for agriculture to contribute to the overall economy.

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APPENDIX 1. AGRICULTURE SHARE IN GDP, EMPLOYMENT AND RURAL SHARE IN POVERTY, 1997-2011.

Asian Country	Share of Agriculture in GDP (%) *	Employment in Agriculture (%) **	Rural Share in Poverty (% of Total Poor)***
Agriculture-Based Countries:			
Afghanistan	36.44	68.30	69.00
Lao PDR	40.84	53.29	62.14
Myanmar	55.71	69.02	-
Nepal	37.36	93.12	78.28
Cambodia	36.51	62.11	60.62
Vietnam	22.48	65.69	84.51
Bangladesh	21.75	51.04	60.73
Bhutan	25.44	92.71	92.14
Mongolia	24.09	21.66	55.29
Pakistan	23.13	41.79	64.32
Transforming Economies:			
India	20.59	57.23	61.87
Maldives	7.80	19.61	-
Sri Lanka	15.40	44.30	71.45
Indonesia	15.43	45.52	60.99
Malaysia	9.79	16.39	81.55
Philippines	13.62	37.21	70.22
Thailand	10.49	75.98	76.07
China	13.13	57.23	63.86
Urbanized:			
Japan	1.34	3.29	-
Korea, Rep.	3.83	7.98	-

* Source: World Development Bank website

** Source: Food and Agriculture Website

*** Computed using the WDI website data on rural and urban poverty. Data span vary per country but averages are between 1997-2011

- No available data

APPENDIX 2. RESULTS OF ADF TESTS: AGR EQUATION.

Country	AGR					
	Levels			First Differences*		
Agriculture-Based	Zero Mean	Single Mean	Trend	Zero Mean	Single Mean	Trend
Bangladesh	0.9950	0.9999	0.9997	0.8051	0.8791	0.2680
Bhutan	0.9956	0.9998	0.9996	0.9196	0.8591	0.7552
Cambodia	0.9090	0.9534	0.7288	0.2777	0.5457	0.7218
Lao	0.9960	0.9357	0.2097	0.0383	0.0190	0.1036
Mongolia	0.7422	0.1323	0.1395	0.0008	0.0108	0.0525
Nepal	0.9269	0.0091	0.1498	0.0017	0.0172	0.0427
Pakistan	0.9548	0.2833	0.9483	0.1496	0.2726	0.0981
Vietnam	0.9989	0.9857	0.3015	0.7388	0.3410	0.9234
Transforming Asia						
China	0.9906	0.9999	0.9966	0.7026	0.8420	0.0122
India	0.9294	0.9790	0.4299	0.0669	0.2399	0.4145
Indonesia	0.9976	0.9999	0.9983	0.3194	0.3274	0.1471
Malaysia	0.9997	0.9999	0.9993	0.3025	0.2462	.1382
Maldives	0.7422	0.1323	0.1395	0.0008	0.0108	0.0525
Philippines	0.9252	0.8793	0.5690	0.0694	0.1915	0.4332
Sri Lanka	0.9727	0.9895	0.7117	0.0714	0.1411	0.2615
Thailand	0.9999	0.9996	0.9341	0.0706	0.0168	0.0133

*AGR series on countries not integrated of order I(1) are all I(2) when tested further.

APPENDIX 3. RESULTS OF ADF TEST: GDP EQUATION.

Country	GDP					
	Levels			First Differences*		
Agriculture-Based	Zero Mea	Single Mear	Trend	Zero Mean	Single Mean	Trend
Bangladesh	0.9613	0.9999	0.9999	0.9987	0.9979	0.8795
Bhutan	0.9956	0.9998	0.9996	0.9196	0.8591	0.7552
Cambodia	0.9948	0.9991	0.9454	0.8870	0.7257	0.6260
Lao	0.9948	0.9999	0.9999	0.9615	0.9084	0.4477
Mongolia	0.9810	0.9998	0.9999	0.4504	0.7526	0.5771
Nepal	0.9999	0.9991	0.4936	0.4750	0.0035	0.0161
Pakistan	0.9797	0.9542	0.4930	0.2848	0.3446	0.6803
Vietnam	0.9967	0.9991	0.9538	0.8728	0.5676	0.5443
Transforming Asia						
China	0.9990	0.9999	0.9999	0.9916	0.9926	0.9003
India	0.8903	0.9565	0.1813	0.0087	0.0238	0.0014
Indonesia	0.9844	0.9803	0.5323	0.4497	0.3605	0.6336
Malaysia	0.9810	0.9998	0.9999	0.4504	0.7526	0.5771
Maldives	0.9810	0.9998	0.9929	0.4504	0.7526	0.5771
Philippines	0.8903	0.9565	0.1813	0.0087	0.0238	0.0014
Sri Lanka	0.9696	0.9999	0.9999	0.9674	0.9829	0.7351
Thailand	0.9466	0.7788	0.2714	0.1455	0.1274	0.3516

*GDP series on countries not integrated of order I(1) are all I(2) when tested further.

APPENDIX 4. DIAGNOSTIC TESTS: AGRICULTURE-BASED COUNTRIES

Country	R-square	Durbin Watson (DW) Ho: Residuals are uncorrelated		Normality Ho: Residuals are normal	ARCH Ho: Residuals have equal variances (up to order 5)	Ramsey Test (Power 2)
		Pr < DW	Pr > DW	Pr > ChiSq	Pr > LM	Pr > F
Model 2						
Bangladesh	0.9996	0.8845	0.1155	0.0920	0.7603	0.3189
Cambodia	0.9954	0.9306	0.0694	0.5486	0.9725	0.1796
Mongolia	0.9672	0.7740	0.2260	0.5305	0.1235	0.2960
Nepal	0.9754	0.8440	0.1560	0.9785	0.0477	0.5783
Pakistan	0.9878	0.9274	0.0726	0.5875	0.2434	0.3846
Vietnam	0.9946	0.1075	0.8925	0.4620	0.7310	0.1530
Model 1						
Bangladesh	0.9997	0.2316	0.7684	0.7353	0.2537	0.2474
Cambodia	0.9933	0.8956	0.1044	0.7031	0.3161	0.9057
Mongolia	0.9641	0.7907	0.2093	0.7869	0.0058	0.2390
Nepal	0.9928	0.7885	0.2115	0.5331	0.0154	0.2157
Pakistan	0.9941	0.9484	0.0516	0.4666	0.0877	0.7333
Vietnam	0.9947	0.1263	0.8737	0.9837	0.4596	0.0237

APPENDIX 5. DIAGNOSTIC TESTS: TRANSFORMING ASIA

Country	R-square	Durbin Watson (DW) Ho: Residuals are uncorrelated		Normality Ho: Residuals are normal Pr > ChiSq	ARCH - Ho: Residuals have equal variances (up to order 5) Pr > LM	Ramsey Test (Power 2) Pr > F
		Pr < DW	Pr > DW			
Model 2						
China	0.9983	0.1682	0.8318	0.6613	0.6194	0.4719
India	0.9877	0.2363	0.7637	0.3829	0.4973	0.0086
Indonesia	0.9471	0.2433	0.7567	0.0125	0.3719	0.3240
Malaysia	0.9837	0.3210	0.6790	0.6644	0.5442	0.6580
Maldives	0.9936	0.7650	0.2350	0.4927	0.0652	0.0811
Philippines	0.9666	0.0862	0.9138	0.2422	0.7861	0.0028
Sri Lanka	0.9656	0.0628	0.9372	0.8346	0.7630	0.4511
Thailand	0.9314	0.0948	0.9052	0.7048	0.1466	0.0120
Model 1						
China	0.9970	0.4229	0.5771	<.0001	0.2013	0.1308
India	0.9969	0.3734	0.6266	<.0001	0.2013	0.1308
Indonesia	0.9840	0.4610	0.5390	0.7386	0.0878	0.0844
Malaysia	0.9907	0.1297	0.8703	0.0267	0.3653	0.0343
Maldives	0.9664	0.7994	0.2006	0.7943	0.0018	0.0723
Philippines	0.9540	0.1064	0.8936	0.0007	0.9235	0.0155
Sri Lanka	0.9977	0.3240	0.6760	0.4206	0.9644	0.5691
Thailand	0.9895	0.8472	0.1528	0.0144	0.1083	0.0858

APPENDIX 6. NTB PENALTY OF THE TRADE FREEDOM INDEX

The penalty of 5, 10, 15, or 20 points is assigned according to the following scale:

Penalty	NTB's condition
20	NTBs are used extensively across many goods and services and/or act to effectively impede a significant amount of international trade.
15	NTBs are widespread across many goods and services and/or act to impede a majority of potential international trade.
10	NTBs are used to protect certain goods and services and impede some international trade.
5	NTBs are uncommon, protecting few goods and services, and/or have very limited impact on international trade.
0	NTBs are not used to limit international trade.

Source: http://www.heritage.org/index/trade-freedom

The extent of NTBs in a country's trade policy regime is determined using both qualitative and quantitative information. Restrictive rules that hinder trade vary widely, and their overlapping and shifting nature makes their complexity difficult to gauge. The categories of NTBs considered in the penalty include:

Quantity restrictions. These cover import quotas, export limitations, voluntary export restraints, import–export embargoes and bans, countertrade, etc.

Price restrictions. These include antidumping duties, countervailing duties, border tax adjustments, and variable levies/tariff rate quotas.

Regulatory restrictions. Licensing, domestic content and mixing requirements, sanitary and phytosanitary standards (SPSs), safety and industrial standards regulations, packaging, labeling, and trademark regulations, advertising and media regulations are include considered here.

Investment restrictions. These cover exchange and other financial controls.

Customs restrictions. Advance deposit requirements, customs valuation procedures, customs classification procedures, customs clearance procedures are under this classification.

Direct government interventions. These include subsidies and other aid, government industrial policy and regional development measures, government-financed research and other technology policies, national taxes and social insurance, competition policies, immigration policies, government procurement policies, state trading, government monopolies, and exclusive franchises.

APPENDIX 7. HOW MACROECONOMIC VARIABLES ARE MEASURED[24]

GDP per Capita. It is the gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Agriculture-Value Added. Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in constant 2005 U.S. dollars.

Exports of goods and services. The data represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.

The data described above are in constant 2005 U.S. dollars.

[24] Source: World Development Indicator.

APPENDIX 8. BARRO AND LEE'S 2013 MEASURE OF AVERAGE YEARS OF SCHOOLING[25].

The number of years of schooling for the population aged 15 and above, s_t, is constructed as

$$s_t = \sum_{a=1}^{A} l_t^a s_t^a \tag{3}$$

where l_t^a : the population share of group g in population 15 and above and s_t^a : the number of years of schooling of age group *a*— *(a* =1: 15–19 age group, *a* =2: 20–24 age group, … , *a* =13: 75 and above).

The number of years of schooling of age group *a* in time *t* is

$$s_t^a = \sum_j h_{j,t}^a Dur_{j,t}^a \tag{4}$$

where h_j^a the fraction of group *a* having attained the educational level $j = p, s$ *(incomplete, complete)*, *h (incomplete, complete)*, and *Dur* indicates the corresponding duration in years.

The duration is the typical duration of primary and the two levels of secondary education for each country (available from issues of UNESCO, *Statistical Yearbook*), It is constructed by taking account of changes in the duration system over time in a country. We suppose that changes in the duration of schooling at the primary or secondary level applied to new entrants in primary or secondary school (that is, ages 5–9 or ages 10-14) at the time of change. For higher education, we used a duration of four years for all countries and for all years, and we assigned two years to persons who entered tertiary school but did not complete it.

[25] Extracted from Barro and Lee's paper (2013) p. 188.

VITA

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